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# AVIATION

*The Oldest American Aeronautical Magazine*

## IN THIS ISSUE

### FLIGHT TESTING ON A BUSINESS BASIS

— first of a series of three articles by Eddie Allen who gave his life for a cause.

★

### CONTROLLED MATERIALS PLAN

— the aviation industry's place in this vital program.

★

### ABSENTEEISM

— its causes, effects, and aviation's cures.

★

### CONSOLIDATED AIRCRAFT CELEBRATES ITS TWENTIETH ANNIVERSARY

★

### BOMBERS AND CARGO TRANSPORTS FROM THE SAME ASSEMBLY LINE

★

### MODIFICATION CENTERS

— the first detailed revelation of their function.

★

### AIRCRAFT SERVICE ORGANIZATIONS

— the gateway to sound operation.

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### POST-WAR EUROPEAN AIRWAYS

— food for thought on the rehabilitation of Europe.

★

### AIRLINE FINANCIAL PROSPECTUS

— new light thrown on carriers' securities position.



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**Just prior to his tragic death, Eddie Allen completed the first of a series of three articles: the Avianator, and proposed ideas and rough drafts of the remaining two. Al Reed shall take point for Boeing for the last time, sorry, in completing these drafts for the next two issues. Thus Allen's ideas, which have meant so much to the industry, will be presented through the able collaboration of Reed. The first in this series begins on.....** **Page 108**

**The Consolidated Materials Plan is a No. 2 answer for destruction in the aviation industry today. An intimate survey of aspects of both government and industry winds on the merits of the plan as presently contemplated is summarized on.....** **Page 114**

**Automation is a major problem, usually affecting aircraft production. It is the fault of neither labor nor management, but rather an inevitable circumstance of the hours. However, if present a serious problem and production is to become a reality, steps are taken to combat it. A clear-cut analysis of the reasons for automation, its effects, and steps now being taken to control it is presented on.....** **Page 116**

**Consolidated Aircraft Corp., in its 29th anniversary year, is completing a succession of mergers which will make it the world's largest single aviation company. Avianator heretofore presents an historical summary of how this vast and significant enterprise came to be, and follows up with these feature articles on some of its general phases of operation.....** **Page 120**

**Of all the airplane types produced by Consolidated, the B-24 Liberator bomber is the greatest quantity production craft. A machine of highly efficient characteristics, it was found to be an ideal model for maximum mass steps as well as mass output. The environment is called the C-17 Liberator Express, and through a magnified design and production achievement, both B-24's and C-17's are rolled off the same assembly line at Consolidated's Tulsa plant. How it is done is described beginning on.....** **Page 126**

**Madison Calkins are an American production invention which give our fighting forces tomorrow's airplanes today—our jump ahead of the enemy. The first detailed description of this important production phase, designed to reduce quantity production loss of back pressure built up by costly engineering change orders, is presented in this issue by Glenn Holbrook, of Consolidated.....** **Page 136**



**Arthur L. Forster, Director of Services, Bell Aircraft Corp., whose article on page 221 describes the aircraft manufacturing service organization as the gateway to mass production. Mr. Forster is not new to Avianator readers. Most will remember this significant article appearing in the Dec., 1941 issue, after he had established the Bell Service organization in England. The basic philosophy reflected by the speaking of his activities is a truly idealized basis for the speed of the war. Mr. Forster probably an even more important article of records and facts to demonstrate the value and need of organized service by manufacturing.....**

**Knowledge of physics is becoming more and more essential to aircraft design. Their application is rapidly becoming widespread and will increase in the future. For the first in a series of articles describing the characteristics of physics applicable to normal structures are "Early on Physics".....** **Page 140**

**Good test planning is necessary for successful quantity aircraft production. First of two articles describing 30 years in making job analysis, prerequisite to test planning appear on.....** **Page 144**

**Visualization of airflow has been a factor of prime importance in the advancement of the science of aerodynamics. An article reviewing important preliminary work in this technique, together with a description of the author's original work in designing apparatus to carry surface studies to a more advanced stage, appears in this number.....** **Page 148**

**Aircraft advancement in the art of reproducing left hands is the Photo-**

**print Process. It is described in detail beginning on.....** **Page 154**

**Continuing the important series on design considerations for piped structures, the fourth article goes beyond the fundamental considerations of weight saving in discussing considerations in wing design which results in considerably improved structures and economy in materials and costs of fabricating them.....** **Page 164**

**Proper mass of compressed air installations in the future article in the Factory Maintenance Section. Listed as "Industrial Technology," this consideration must be properly stated for production interruptions are to be avoided.....** **Page 170**

**In the Substructure Section, the Consolidated system for manufacturing wheels is described—a new approach to work designed as a manner to meet the special manpower and material problems.....** **Page 172**

**Paul War Efforts in Europe will be an important factor in the establishment of that desirable outcome and will have a considerable effect on the price. In the Transport Section is an article that provides much food for thought for the subject.....** **Page 202**

**Also in the Transport Section is a comprehensive review of the shifting prospects for airline revenue and profits in Avianator's financial section.....** **Page 206**

**In the Military Section is the first in a series of articles outlining the development of gun barrels for military aircraft. These articles contain a most comprehensive review of details of barrel construction, and the first world's most recent construction details of the famous British barrels, which need in Great Britain.....** **Page 227**

**A summary of papers presented before the 26th annual meeting of the SAE at Detroit appears on page 177. In the Flying Equipment section, (page 245) there is a description of the new Grumman fighter-bomber, the McDonnell V-173A.....**

**Among the other regular Avianator features to be found in this issue are the Scotch Book of Design Detail (page 161); Engineering Data Book, giving the most up-to-date specifications for aircraft steel tubing and producing instructions (page 169); and the Maintenance Notebook.....** **Page 219**



Among the many other features of Aero-Quality Lumarith, its protection for the skin against severe sunburn is of particular interest.

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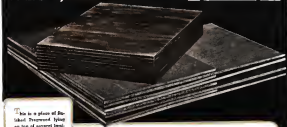
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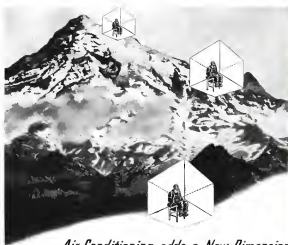
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**GENERAL ELECTRIC**



## Pied Piper of the Pacific

Getting rid of rats takes on a new dimension as the rats of the world move to conquer Asia today. And aviation is a better job being done of it than by the gallant members of the U. S. Army Air Force. For aviation is the swiftest method of the world of the Silver Star to Lt. Clifton H. Treadwell from General MacArthur's Headquarters, Australia, October 1945.



With the devastating fire power of his cannon bearing P-39 Aircraft, this modern Pied Piper of the air destroys the rats which threatened to overrun civilization.

When the rats are gone, he'll come back to a world in which the technical advances that war has brought to Aviation will be put to even greater use. We, at Bell

Aircraft, will have the engineering ability, the means of production and—most important—the tradition of Aviation pioneering to play our part in that coming era. © Bell Aircraft Corporation, Buffalo, New York

*Airacobras for victory—*  
**BELL** *Aircraft*  
FUTURE PLANS FOR PEACE  
PACEMAKER OF AVIATION PROGRESS



Weather Today:  
Strong Winds turning to

# HURRICANE

(if required)

• Hurricane? No hurricane of record even could approach the 200-mile-an-hour man-made tempest which will be turned on and off at will in the new Curtiss wind tunnel. One of the world's two largest, it is but part of the modern equipment in the new Curtiss Research Laboratory where all of the complex phases of tomorrow's aviation will be explored.

Here is impressive evidence that the aviation industry is looking ahead to the skies of the future—to a non-fortuitous day when giant passenger liners... huge cargo carriers... luxurious private craft... fighters, bombers, battleships of the air... will fly at altitudes and speeds eclipsing anything that the world knows today.

**CURTIS WRIGHT**  
Corporation  
AIRPLANE DIVISION



## 1. DON'T "OVER-WELD" FILLET JOINTS

If a job calls for a 3/16" fillet, don't pile on extra electrode metal to play safe. Proper joint design includes an ample safety factor, and exceeding design dimensions merely wastes elec-

trodes. For instance, if dimensions are doubled—to 3/8" legs instead of 3/16"—four times as much deposit metal is used. Check with your fillet weld gauge whenever in doubt.

## 2. USE THE LARGEST ELECTRODE AVAILABLE

Using larger diameter electrodes speeds up deposition of metal, and choosing an 18" length instead of 14" means fewer electrode changes for a

given length of weld.

Following this method will increase welding speed 25% to 50% and also save 3%-4% stub loss.

• These are only two ways to get the most useful work out of every electrode. More suggestions are shown below. Follow these rules and see that all your welders observe them. In this way you can stretch your supply of electrodes during the present shortage.

## CONSERVE ELECTRODES FOR VICTORY!

Use electrodes down to a 2" stub. Make legs of fillet welds equal. Make face of fillet welds flat. Store welding electrodes in a dry place.



40 EAST 42nd STREET, NEW YORK, N. Y.

In Texas: Magnolia-Alcoa Gas Products Co.

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100 CYLINDERS ARE PRODUCTION SLACKERS. KEEP 'EM ROLLING FOR VICTORY!

AVIATION, April, 1948





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was also very good at spotting trouble in

DOI: 10.1002/for

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**Authors:** \_\_\_\_\_

Fig. 1. *Staphylococcus aureus* strains.

**Keywords:** child sexual abuse; disclosure; social support

• Captain Maxwell W. Bullock, Director

449 p. 894c. (London: also another volume 161)

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

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by designing most parts for molded Micarta you can eliminate or materially reduce the amount of machining that must be done in your plant or in plants supplying machined parts—thus clearing the decks for production of other parts that can only be produced by machining.

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(page 2)



# Westinghouse

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rants, are now being made  
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But you can in a Lockheed Hudson bomber! Lockheed Hudsons hold the official RAF Coastal Command record for having wounded more subs than any other airplane.

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FOR LEADERSHIP



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### TUBE FORM MOUNTINGS

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This is a typical story of America's Apostle of the Impossible, the inventor, the tinkerer and the bugaboo-basher Edmond who have submitted to the Council more than 50,000 ideas and inventions in less than 24 months. All have been carefully examined, hundreds are being borne tested, and scores are actually at work solving the war and strengthening America's production lines for the postwar pull ahead . . . But America needs more!

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For any counsel or assistance that we can give to you or to any individual in your company on ideas involving the use of precision machine tools, Jones & Lamson engineers and service men are at your call.



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**B**

Simply return them to us for complete reconditioning. This Apex service restores your bits to their original utility, good as new in every aspect. Yet it costs only a fraction of the price of new bits.

**C**

Promptly, you get your bits back, just as tough and serviceable as the original bits. On most sizes of Apex-Phillips bits, reconditioning can be done repeatedly, multiplying service-life many times. You save money and conserve vital tool steel.



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Manufacturers of power bits for Phillips, Skidmore, and Clark hand screws and hand tools for Phillips and Clark hand screws.

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IF WORMS HAD WINGS, chances are our entire economy would collapse! All because their specialty—that of swallowing earth—is unique and indispensable!

The earthworms in a single acre of ground carry more than 18 tons of earthy castings to the surface in a year! Thus, by constant plowing, they make it possible for air, moisture and life-giving minerals to circulate . . . and so for all plants to flourish!

But if worms had wings, they'd never be satisfied with so plebeian an occupation as burrowing. They'd just fly around. And in the meantime, the whole world would go to pot.

The moral is plain: Specialization is all so great!

Importance that our modern world could not survive without it. Our democracy could not light without it. Take machine tool production. We have overcome Germany's 7-year head start in about a year, and are even now outproducing the Reich in machine tools in the ratio of 5 to 1.

A potent factor in this production miracle has been the multiple spindle automatic lathe made by Corb. These titans of the machine tool industry are currently used in the production of so many different munition parts it would be difficult to list them all.

Remember that quote—Corb Multiple Spindle Lathes. It will confirm to right history later, victory is won!

**CORB Automatic Machine Company, Inc., Windsor, Vermont**

## DEFYING the law of gravity

"What goes up must come down" used to apply to motor efficiency. But that was before the introduction. Bush High-Efficiency Interceptors are helping war planes of the United States to fly higher and faster than those of the Axis. And in the battle of the air the "high men" win. This experience applied in the timely hundreds of new commercial and industrial engine applications which will be available when the war is won, may well make you "high men" in your field.

## BUSH MANUFACTURING CO.

HARTFORD, CONNECTICUT • NEW BRITAIN, NEW HAVEN



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In the vernacular of the R.A.F., they're "way up on the profit side"...which means, they cause back home *reels* to go apail! Besides their great protective armament, these big battleships-of-the-air are fast and highly maneuverable. With three engines "out", they can still get home...AND that's engineering, that's CONTROL! Over 1200 *Fafnir* Aircraft

Ball Bearings help to make such control possible.

In wartime, just as in peacetime, SAFETY depends to a large degree on the free-acting efficiency of a plane's control system. As new planes have been developed, and old ones improved, new bearing problems have presented themselves. Working closely with aircraft engineers, Fafnir engineers have kept pace with these changes and have been ready with standard and special designs to fulfill these rapidly changing requirements. The Fafnir Bearing Company, Aursch Division, New Britain, Conn.

Send for copies before Aircraft Service Manual, you will find it an invaluable service guide.

**FAFNIR**  
Ball Bearings  
for Aircraft  
Engines and Controls

## KEEP MATERIALS FLOWING on those short moves

from one process to the other . . . . .

**Automatic PALLET TRANSPORTER**



For use with either open or double faced pallets . . . loads up to 4000 lbs. . .



Forward and reverse speeds—with turning—simple to maintain—maneuverable in restricted aisle ways—no clutch—no brake to operate

- POSITIVE MECHANICAL BRAKE
- FRONT WHEEL POWER DRIVE
- CONTROLS IN STEERING HANDLE
- SHOCKLESS HYDRAULIC PLATFORM LIFT WITH EASY FOOT CONTROL

This patented handleless employee never uses an awkward telescopic pole—no sparks up work—no extra weight still strong in your daily production—it's safe, easy and saves space in your power

Here is positive and continuous help in maintaining a systematic materials handling system. The "AUTOMATIC" Pallet Transporter gives you mechanized handling in intra-plant transportation—receiving raw materials, warehousing them, carrying them to and along the production line, moving and rehandling finished products for shipment.

**NO STRAINING—NO TUGGING—NO PULLING—NO EXTRA PUSHING**—Ready to operate at the truckers command. A movement of the handle, a push of the button, and away it goes at safe walking speed.

**WILL IN THE SOURCE AND MAIL**

**AUTOMATIC TRANSPORTATION CO.**  
45 W. 82ND ST. CHICAGO 24, ILL.  
Customer Service Dept. handles information on the "AUTOMATIC" without obligation.

NAME \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

**AUTOMATIC TRANSPORTATION COMPANY**

45 W. 82ND ST. CHICAGO 24, ILL.

45 W. 82ND ST.

CHICAGO, ILLINOIS

MANUFACTURED FOR OVER 25 YEARS. *Patented, Copyrighted, Registered, U.S. TRADE MARK*





## BOMBER ON THE *"Night Shift"*

*Out of the midnight sky swoops a four-motored thunderbird — an American bomber returning to its base after a cold deep into enemy territory.*

*Suddenly, from giant wings, twin beams of light probe southward. The landing field becomes clearly defined.*

*Notas off now. Propellers switching. A long glide and a smooth balanced landing. And another mission is safely completed.*

To equip American bombers and fighting planes with landing, signal and instrument lighting

of maximum efficiency — particularly for duty on the "night shift" — is part of E. A. Laboratories' warlike responsibility. It's a job we handle with pride. A job we are able to handle largely because of our long experience in the making of automotive equipment and accessories.

Tomorrow, after V-day, we will again supply the motor and aviation industry with home-made E. A. products. But today E. A. management and employees are concentrating with grim singleness of purpose on war production and more production for the armed forces who will win the final victory.

*J. M. Murphy*  
E. A. LABORATORIES, Inc., BROOKLYN, N. Y.

AVIATION, April, 1945

# Only One Objective — *VICTORY!*



The coveted Army-Navy "E" Awarding that now flies above the Wittek plant is a symbol of vital partnership between the war front and the production front. Our nation's highest industrial tribute is, to the men and women of Wittek, a challenge and a responsibility . . . an impulsion to even greater accomplishment in this one objective. . . VICTORY.

Since the beginning of modern transportation Wittek has been a producer of hose clamps for the automotive and aircraft industries. Today—Wittek Hose Clamps are being used by the outstanding military aircraft and combat vehicle manufacturers—Wittek Manufacturing Co., 6305-15 West 24th Place, Chicago.

• Buy War Bonds •

**WITTEK** *Aviation*  
**HOSE CLAMPS**

AVIATION, April, 1945



This advertisement is one of a series which will appear in national magazines and newspapers this year as Consolidated's contribution toward a clearer public understanding of "aviation geography."



# CONSOLIDATED

## YOUR CHILD CAN SHOW YOU A NEW WORLD

MANY a time, when he brings you enough, you're probably giving your child a helping hand with his homework geography.

But now the power is reversed. Today your child can help you with your geography.



From New York to London, there is now a direct air route.



From New York to Moscow, there is now a direct air route.

His modern geography book is adding to him a world that didn't exist when you were in school. A world, for example, in which planes are spanning the Atlantic in a matter of 480 minutes—and a man can travel from New York to Moscow by plane in less time than he can go from New York to Miami by rail—and the route from New York to Bombay is now a 16-hour voyage past Gibraltar and Sicily, but a 40-hour flight where the way routes are belted, Oslo, and Moscow.

So, this new world, the "new" geography you studied as a child has been supplanted by today's "new

new" geography. The earth, and all the people on it, have become a global community. And that's a fact.

But now there have been offshoots. There are small bodies of water



From New York to London, there is now a direct air route.



From New York to Moscow, there is now a direct air route.

By the way, the new world, the "new" geography you studied as a child has been supplanted by today's "new

new" geography. The earth, and all the people on it, have become a global community. And that's a fact.

But now there have been offshoots. There are small bodies of water



From New York to London, there is now a direct air route.



From New York to Moscow, there is now a direct air route.

We must quickly learn to understand it. For only then can we look toward the horizon of the present toward the future and its promise.

One thing is already so clear as though written in well-etched letters in the air. Our growing air power is today becoming a mighty weapon in our hands for Victory. Tomorrow it will be one of the instruments with which freedom-loving nations can help build and enforce an enduring peace.



From New York to London, there is now a direct air route.



From New York to Moscow, there is now a direct air route.

By the way, the new world, the "new" geography you studied as a child has been supplanted by today's "new

new" geography. The earth, and all the people on it, have become a global community. And that's a fact.

But now there have been offshoots. There are small bodies of water



From New York to London, there is now a direct air route.



From New York to Moscow, there is now a direct air route.

### QUICK FACTS FOR AIR-MINDED READERS

There are now thousands of airlines in the world. They are flying to every corner of the globe. They are flying to every corner of the globe.

There are now thousands of airlines in the world. They are flying to every corner of the globe. They are flying to every corner of the globe.

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*Training Casts its SHADOW..*



# JACOBS AIRCRAFT Engines

This shadow is becoming a familiar one over Northfield Europe, and will become increasingly familiar.

The devastating accuracy that accompanies this shadow was born and developed on American Training Fields, where the Army Air Forces Training Command taught the pilot and crew to concentrate on the accomplishment of their mission with precision.

Complete reliability of Training Plane engines is essential for such concentration.

The majority of the twin-engine Training Planes, in which the Bomber Pilot are schooled, are powered by Jacobs. This reliable power enables them to concentrate completely on the precise bombing technique, without a thought to their engines. This same reliable power will also allow thousands of Americans to carry their families and friends through the air with complete security after Victory is won.



**JACOBS AIRCRAFT ENGINE CO.**  
POTTSVILLE • PENNSYLVANIA • U.S.A.



BLANCHARD

## CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

- ★ **Production**
- ★ **Adaptability**
- ★ **Fixture Saving**
- ★ **Operation Saving**
- ★ **Material Saving**
- ★ **Fine Finish**
- ★ **Flatness**
- ★ **Close Limits**



..... Especially  
valuable on jobs like  
the one illustrated.

"PUT IT ON THE BLANCHARD"



Grinding cylinder bushings on  
Blanchard No. 18 Surface Grinder

THESE cylinder bushings,  $3\frac{1}{2}$  inches high by  $3\frac{1}{4}$  inches in diameter, are of extremely thin section, yet they are held securely on the Blanchard No. 18 magnetic chuck. These bushings are Granite castings .006" of stock is ground off both ends to limits of  $\pm .0005$ " for size, and .0005" for parallelism. 50 pieces (100 surfaces) are ground per hour.

Multiple chucking and grinding on the Blanchard is the sure and economical way to machine parallel surfaces on parts such as these, also on collars, gear blanks, and washers.

The Blanchard Magnetic Chuck is so adaptable to holding a wide variety of work that it takes the place of many expensive fixtures that would be necessary on other types of machines.

*The* **BLANCHARD**  
**MACHINE COMPANY**  
64 STATE STREET, CAMBRIDGE, MASS.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.







## Heard this one about the traveling salesman?

It's about a post-war traveling salesman who made calls on customers in six different towns in one day—and the one he saw at 6:30 in the afternoon was 600 miles away from the city where he ate breakfast! After the war, such lightning covering of sales territories will be commonplace. Any salesman will be able to do it—flying in his own plane!

That plane may be a roadable, folding-wing monoplane; it may be a helicopter; or perhaps a type as yet unheard of. But whatever its shape, chances are it will be powered by a light, economical Franklin engine. For 45 years the genius of Franklin engineers has produced ever-finer air-cooled engines. Franklins were used by every major producer of light planes before the war. Today they are serving in Army and Navy warplanes. And already Franklin engines have powered the leading experimental types—the forerunners of the private-owner planes soon to come. Look for Franklin power in your post-war plane.

AIRCOOLED MOTORS CORPORATION  
SYRACUSE, NEW YORK



AVIATION, April, 1945



## SAFER LANDINGS for FIGHTING PILOTS

# Firestone

### CHANNEL TREAD AIRCRAFT TIRES

**F**AST fighting aircraft, landing on the decks of carriers, or on rough fields hastily improvised on desert or beach or jungle, to refuel and re-arm and carry the fight back to Nazi or Jap—imposed burdens on wheels and tires never heard of before.

At stake were the lives of pilots, the aircraft, the lives and the precious rubber they were made of. All must be conserved. These problems came to Firestone and

Firestone came up with the answer. It is found in the revolutionary Channel Tread Tire. Its high shoulder and wide tread hump to take the punishment of these cruel landings, delivering up to ten times more than previous types. No wonder pilots swear by them — no wonder they have been standardized on most fast fighters.

Firestone is with these Fighting Pilots, and Fighting Planes, in Victory, and After!

Shown in the Victory of France with Richard Cordell, Margaret Keane and the Famous Symphony Orchestra, under direction of Alfred Wallenstein, identical coverings over N. B. C.

**FIRESTONE AIRCRAFT COMPANY**  
AKRON, OHIO      LOS ANGELES, CALIF.





**FROM THE LARGEST  
BOLT, NUT, SCREW OR RIVET  
TO THE TINIEST, SO COMPLETE AND DIVERSE**

are the facilities of "National Screw," that we can make most any size and type of fastener for Aircraft . . . And to the rigid specifications that "A-N" Aircraft work demands.

Many a critical production line has been kept moving because "National Screw" was able to deliver a difficult fastener in quantity, quickly.



THE NATIONAL SCREW & MFG. CO., CLEVELAND, OHIO

BUY  
WAR BONDS  
FOR  
VICTORY

*Spot* THIS PLANE AND YOU  
SPOT ADEL EQUIPMENT

Now you see it—NOW you don't! The way it strikes past, no wonder they call it *Lightning Fast*! Yes, indeed, but instantly recognizable to the 1,800,000 patriotic Aircraft Warning Service volunteers patrolling our coastal areas. They call it "three-bullets-on-a-knife!"

internationally famous as a Jap and Nam killer after but a few months combat service, Lockheed's P-51 demands top performance from its accessories—performance achievable only thru design simplicity. We're proud to advertise that this great American fighter is equipped with special and standardised ADEL hydraulic, anti-icing and line support equipment.

**ADEL** PRECISION PRODUCTS CORP.  
MURBANK, CALIFORNIA

**FLYING TO VICTORY WITH THE OBVIOUS NAME IS AN ADVANTAGE:** Bank Jet System Services Coordinated: Canair Europe, Hughes, G & S, Gyman, Inland, Maple, McDonnell, New American, Northern, Republic, Swiss, Swiss, Vega, Knight-Sheridan, Valco, West. In Canada: Swiss Canadian Air & Freeway Canadian FLIGHTS: In Scotland, Fairchild, Finesse, British, McDonnell Douglas, Henderson, Jetstream, United, Viking Airways.



P-28 Lightbulbs





This advertisement is one of a series appearing regularly in national journals, foreign publications, and prominent city newspapers. Requests for full color are available for your use. Write us for them.



Republuc Steel and its products are featured in the background of this advertisement.

## "Now... if I was down there in Washington..."

That's Joe talking. Every night when he goes to bed he thinks and wonders how his place in all the boys about here this war should be won. Maybe he's right and maybe he isn't.

The important thing is that he can say what he thinks—and loud. Right in front of Tom Barlow, the top. He couldn't do that in Germany or Japan or Italy... or in any of the nations that have been "liberated" by the New Order.

But Joe is an American.

And because Joe is an American, he has more privileges—and more responsibilities—than can be found anywhere else in the world.

If he doesn't want to work for somebody else, he can operate a business of his own—anywhere. Joe is a free guy! His future is under his hat. Like millions of other Americans on the way up,

Joe can cash in on a way of life that has brought America the highest standards of living in the world—by a big margin.

It is a typically American way of life—based on American ingenuity, initiative, desire to get ahead. It gives every person a chance.

That is why today, after a comparatively short time, teamwork and cooperation in American industry and American agriculture are performing miracles of production that would be impossible in a country weakened by years of repression and dictatorship.

That is why the steel industry—in which Republic holds a leading position—has been able to "come through" with the tools and metal products for our Nation's greatest armament and shipbuilding programs. In 1942 Republic operated at 99.3% of capacity for the entire year. And the nearly 70,000 Republic men and women supporting

our fighting forces\* have the 1942 record by 470,000 tons.

That, too, is why Republic chemists, metallurgists and engineers are constantly searching for—and finding—new and improved ways of making these metals.

And that is why you can look with faith on the future—when money will insure our free way of life—when you and we can sit at the job we want to do now—produce peace-time products to make America a better, happier, safer place in which to live.

Until then, we have a big job to do. LET'S DO IT WELL and get it finished in a hurry. And let's guard faithfully our American way of life!

\*Over 12,000 Republic men are now in uniform.

### REPUBLIC STEEL CORPORATION

General Offices: Cleveland, Ohio  
Branches: Birmingham, Chicago, St. Louis, St. Paul, Pittsburgh, Portland, Seattle, Toledo, Wash. D.C., Youngstown, Ohio  
Export Department: Chrysler Building, New York, N.Y.



# Republic

## ALLOY AND ENDURO STAINLESS STEELS

Electronic Aircraft Tubing, Union Bolts—Nuts—Rivets, Pipe, Sheets, Truscon Hangar Doors and Building Products.



SO THEY CAN

## Forget ABOUT MOTORS



Through engineering... exacting manufacture... rigid inspection and testing—these are the high standards we maintain to secure complete dependability in every Black & Decker motor.

Long experience in the field of special application motors, combined with a thorough knowledge of the severe demands made on aircraft equipment, have proved to us the importance of designing and building vital dependability right into every part.

This type of dependability will also be available for the motor-operated equipment you are planning to build in the future.

THE BLACK & DECKER ELECTRIC COMPANY  
KENT, OHIO

# Black & Decker

## MOTORS

SPECIAL APPLICATION ★ FRACTIONAL HORSEPOWER



# YOU CAN'T DO THAT!

● Those four words often spell the difference between success and failure. When experts solemnly declare "You can't do THAT!" many people "fold their tents as the Arabs and silently steal away." But to the Spriesch Tool & Manufacturing Co., Inc. it's a challenge—a challenge to our ingenuity.

● The entire Spriesch organization prides itself on doing the impossible. It matters not whether the problem involves a single mechanical part or a complete assembly. No job is too small—none too large. We are equipped to do the tooling or go into production on the complete assembly. And the job will be done quickly and at reasonable cost.

● That's why Spriesch today is working 24 hours a day, seven days a week producing aircraft armament devices—automatic bomb-release racks and shackles, etc.—and producing them on schedule with a remarkably low percentage of rejections. We're flattered to hear it spoken of as Spriesch miracle-war production.

● After Victory our extensive facilities will be available to you—no matter what your mechanical production problem may be.

If you have need of special tooling, if you'd like to put an inventor's dream into production, if you have precision work you can't get in your own plant—make a note to submit it to us....

*After Victory*

Meanwhile, to assist you with our facilities and speed, write (on your business letterhead, please) for our brochure "Ingenuity." It will give you a comprehensive view of what we have to offer.



*Joseph J. Cheney*  
President

WE OFFER INGENUITY...

our extensive facilities to produce intricate or simple designs—precision tooling or mass production—complete assemblies or parts.

• AFTER VICTORY •

Established 1925

**Spriesch** TOOL & MANUFACTURING CO., Inc.  
17 HOWARD STREET • • • BUFFALO, NEW YORK

ATTENTION, April, 1945

## A FIFTH FREEDOM



To the four freedoms, will be added some day, a fifth freedom—freedom of flight. But it can't come till victory has subdued the other four. Then... freedom to fly with safety, with economy, with comfort and convenience—will mean much to post-war peace and prosperity.

For post-war aircraft will measure trans-oceanic flights in hours, and can literally make all the world, good neighbors. Cities in near-by states will be less than an hour away, and the farther development of

the helicopter, will actually make door-to-door aircraft feasible and possible.

That's something to work for and plan for. But right now we've got something to fight for. We're glad that we, at McDonnell, can add our share to the gigantic contribution which America's aircraft industry is making to victory... and to the preservation of the four freedoms which are fundamental to democracy.

**McDONNELL** Aircraft Corporation  
Manufacturers of PLANES • PARTS • PLASTICS • SAINT LOUIS • MEMPHIS •





We're not interested  
in  
**ZOOT SUITS**

but we are interested  
in the phenomena  
of change...

We're not rag cutters, and we're definitely not "right with the rag." We don't wear a "solid suit of threads," padded at the shoulders like a lunatic's call, with the "jut out" and the "heat pleats," the "cleave sleeves" and the "drape drapes." That sartorial flower-bed of a jowls ago is definitely not down our alley.

We're specialists in internal grinding problems, and Zoot suits (we fervently pray) won't wield their foolish influence upon the wheels of industry... but every a simple fact had. When a boy and a girl once sat in a hammock, and he thrummed a mandolin and she cooily sighed, "I just love your new suit collar!"—the celluloid collar market quickly vanished from this earth... And the horse-and-buggy business employed a million men—and an explosive contraption, deployed as a dangerous foe, notably dumfounded them and put ten times their number to work.

Now, we're not interested in Zoot suits, but we are interested in the phenomena of change. And this is the fastest-changing period in all of industrial history. As a result, many businesses, wittingly or not, are actually on the brink of failure in the post-war world of better and cheaper materials.

We've developed many new techniques in grinding these materials, and we believe that this knowledge can be of greater value to manufacturers today than ever before. Bryant's Consulting Service is available to you at all times, and we urge you to call upon us now!

SEND FOR THE MAN FROM BRYANT

**BRYANT CHUCKING GRINDER CO.**  
SPRINGFIELD, VERMONT, U. S. A.



**E. W. BLISS CO.**  
REVEREND METAL MACHINERY  
ANALYSTS IN CLAM MACHINERY  
EXHAUSTIVE MACHINERY  
EXHAUSTIVE & CO. 10000000

**ENGINEERING  
for  
PRODUCTION**

Mr. B.  
Comptroller  
Calcutta

After some 50 technical enquiries, the...  
are happy to recommend equipment...  
As you know, turning of large cartridge cases presents the  
problem of feeding, and on the ordinary press, requires con-  
siderable time for loading and unloading the dies. Features  
of the press equipment recommended are outlined below:

**Dial Feed Hydrodynamic Tapering Press**

1. Simple loading time; no lock press time
2. Shockless and silent operation of dial
3. Production of 7 to 10 per minute
4. Fully automatic operation of the entire cycle
5. Perfect alignment
6. Tapering to shoulder
7. Safety interlocks on controls throughout
8. Automatic hydraulic ejection
9. Same rigidity as on Bliss cartridge case presses
10. Adjustable for different case sizes

Illustrations of this press in the 371 ton 60" stroke size are  
enclosed and a detailed question attached. We hope that we  
will have the pleasure of hearing further from you.

**DIAL FEED  
HYDRAULIC  
TAPERING**

**W. BLISS CO.**  
Street and Second Avenue  
JOKLYN • NEW YORK

**BLISS**

Yours very truly,  
E. W. BLISS COMPANY



# HOW TO ERECT Hangars, Maintenance Shops, Housing, FAST— WITH MINIMUM USE OF CRITICAL MATERIALS!

**CELOTEX CEMENTO** is more than a revolutionary new building material. It makes possible a whole new method of construction—equally applicable to wartime housing and wartime factory construction. Each sec-

tion of Cemetex is a complete wall unit—replacing all materials needed for a conventional wall, including exterior and interior finish! And installation? **TIME—THROUGH—NUTS!**—there are three of the most important savings in

Cemetex construction, under existing emergency conditions. These pictures show progress during the building of women's dormitories at Washington Park Project at Washington, D. C.



Cemetex handles easily, but this composite gains speed by using the wooden rig shown.



Workers using another Cemetex section into place... ready to be rolled by the crane.



Cemetex's strength allows easy work with steel for temporary support, even further and scaling.



Good-looking, permanent Cemetex wall will never need painting or other exterior finish.



Close-up shows perfect joint, no seepage, waterproof, permanently secure joint, too.



Building wall for two stories, 2 stories, over 300 ft long, over 340 ft wide, for 400 occupants.



**CELOTEX CEMENTO** is a fast and accurate, strong wall and ceiling of a free-free concrete unit with no mortar, cement, sand or brick. It is a precast material making a finished, insulated wall and ceiling with complete exterior and interior finish. The composite unit is made of concrete and cement. Customer satisfaction is the primary objective of Cemetex. If you know more of your problems, ask for the FREE 12-page booklet, "A Word About Cemetex."

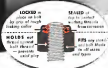
**CELOTEX CEMENTO**  
INSULATING WALL UNITS

The word Cemetex has found some splendid group of products marketed by The Celotex Corporation.

THE CELOTEX CORPORATION • CHICAGO



**THESE ARE THE NUTS  
FOR TOUGH JOBS**



War jobs have posed infinite production problems. We know a lot of them that were solved with as simple a thing as a nut.

Because the solution was an Elastic Stop Nut.

For example, aircraft. Their very worth depends upon fastenings that grip sure and won't shake loose under the chatter of machine guns, the impact of cannon fire and the vibration of air combat.

Every plane streaming off America's production lines has Elastic Stop Nuts fastening important structural parts. Several millions of them go into aircraft every day.

And to our knowledge, not one has ever failed to do its job.

With two big plants running full-tilt 24 hours a

day, we can't satisfy all the needs of today's one big customer.

But in the days ahead, with Elastic Stop Nuts generally available, peacetime products and their production are going to be better.

And our engineers schooled in solving the rigorous problems of war production will be at the service of manufacturers with fastening requirements.

Whenever you wish, they will be ready to share their knowledge with you and recommend the desirable Elastic Stop Nut.

**ELASTIC STOP NUTS**  
Lock, fast to make things last

ELASTIC STOP NUT CORPORATION OF AMERICA  
LAKESIDE, NEW YORK







Cannon Connectors, used wherever electrical connections must be made quickly, safely and securely, now serve as the means for connecting the many electrical circuits used in the control and operation of the weapons of war.

When the war is won, these same Cannon

Connectors will again be available for peacetime consumers on a host of electrical devices not even dreamed of now. And, having passed the rigorous tests of war, they will assure even a higher degree of dependable performance under the less strenuous demands of peaceful living.

## CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles, California

Head Office and Engineering Office: Cannon Electric Company, Limited, Toronto, Canada

Representatives in principal cities—consult your local telephone book

FOR VICTORY BUY WAR BONDS AND STAMPS



AVIATION, April, 1943

# Break up that PRODUCTION JAM

Have the shortages of forged parts cut your castings stopped the smooth flow of work at your plant? If so, then **PRESSURE MOLD CASTING** of these parts may break the production jam and help you get back on schedule. This **NEW** casting method—of forcing molten aluminum alloys into steel molds—does a better job faster, and is fully covered by Army Air Force Specification number 11340.

2-WAY 3-WAY 4-WAY

### Consider these advantages of HARVILL Pressure Mold Casting

**SAVES TIME**—On the plug valves shown above 32% of machining is eliminated. Once made, they made production time a cinch to produce. **SAVES MATERIAL**—30 to 100% more valves are produced from one ingot than by any other accepted production method. **CUTS REJECTION**—With a plus or minus .001 to .002 tolerance and greater quality consistency than any other casting method, Pressure Mold Casting cuts rejection to practically "nil". **SAVES TOOLS AND LABOR**—Maintenance of these dimensional tolerances

decreases machine shop operations—steps up production—meets army and navy. **SAVES** installing and cutting methods developed to 32 years of research, assure high material strength and uniform quality. Special production control and inspection techniques underwrite every Pressure Mold-Casting. **IF** you want to **STRENGTHEN** your production of complex structural parts—see HARVILL. **FOR** more information, write to the company. Write to Harvill's Technical Service Department for complete information.

Division Representative  
HARVILL PRESSURE CASTING  
HARVILL PRESSURE CASTING CO.  
HARVILL PRESSURE CASTING CO.

# HARVILL Corporation

HARVILL PRESSURE CASTING CO. HARVILL PRESSURE CASTING CO. HARVILL PRESSURE CASTING CO.

4250 WEST CENTURY ROAD,  
LOS ANGELES, CALIFORNIA

### OTHER HARVILL PRODUCTS OR SERVICES

**HARVILL PRODUCTS**  
A wide variety of products are available for your specific requirements. Write to Harvill for complete information.

**NEW ENGINES**  
A wide variety of engines are available for your specific requirements. Write to Harvill for complete information.

**ALUMINUM PARTS**  
A wide variety of aluminum parts are available for your specific requirements. Write to Harvill for complete information.

**FLUID TIGHT**  
A wide variety of fluid tight parts are available for your specific requirements. Write to Harvill for complete information.

AVIATION, April, 1943

29





Pupils of eyes contract when harsh light from a glowing instrument panel reflects through a night-fighter pilot. The pilot makes it difficult for him to

read his instruments. Also, it distracts the "dark-adaptation" of his eyes, so that he can't see objects in the darkness better the plane.



See how pupils expand when glare is removed. Illumination in this photo approximates that of a well-adjusted glow-free scene. It would be fine for

most visual tasks, but it is unsatisfactory for eyes at night-fighter plane because pilot still couldn't see objects in surrounding darkness.



When eyes are "dark adapted" pupils are very large and complete adjustment "dark adaptation" of pilot's eyes since surrounding light is eliminated

from G-E's RP-12 lamp makes necessary dark adaptation of pilot's eyes since surrounding light is eliminated



The RP-12 is a cathode-glow type of lamp. The electrode-glow produces sharp ultraviolet radiation. Phosphor coating on inside of lamp converts this into long ultraviolet waves which increase the fluorescent materials on the instrument markings, making them visible.



Visual display parts are improved with aid of G-E fluorescent lighting. Improvement in making this type of lamp helped development of RP-12.

## HOW G-E FLUORESCENT RESEARCH IMPROVED NIGHT FLYING

**Unique New Aviation Lamp Is Outgrowth of G-E Research in Fluorescent Lamps for Industrial Use.**

NIGHT fighter pilots were having trouble. Two things were wrong. Either could be fatal. The first was glare from the instrument panel, which made it hard to read dash quickly. The second deficiency arose from the first. The eyes of a night-fighter pilot must be adapted to the dark if he is to

see planes or other objects in the darkness surrounding him. But satisfactory "dark-adaptation" could not be achieved while the pilot's eyes were conditioned to the high brightness of a glowing instrument panel.

Now G-E research began paying. Here was a challenge made to order for General Electric research scientists. The first solution was a miniature version of the large G-E MAZDA fluorescent lamp used for industrial lighting. Instead of visible light, however, it

produced ultra-violet energy ("black light"), which activated special fluorescent materials on the dash. It eliminated glare, but required heavy, bulky auxiliary equipment. Space and weight are at a premium in a fighter plane.

So G-E research scientists produced a radical new lamp—the RP-12. It emits "black light" to make instrument dash fluorescent but needs no heavy auxiliary equipment. It eliminates glare. The pilot can control the brightness of the instrument dash in conformity with the volume of your radio, thus

aiding dark adaptation of his eyes. It makes up little space. It is efficient and strong.

AND BY MEANS OF LAMPS AT WAR The vast store of knowledge gained in developing the G-E MAZDA fluorescent lamps that speed production in war industry was fundamental to developments of the RP-12, as was G-E experience with certain types of ion lamps. And volume production of high-quality RP-12 lamps would not be possible without General Electric's years of experience in lamp manufac-

turing techniques and methods of testing to assure uniform quality.

The RP-12 is only one of many General Electric lamps used by the armed forces of the United States. All of them are built to the same standards of quality that distinguish G-E MAZDA lamps for war industry and the home. Lamp efficiency and lamp quality depend on many factors. General Electric research is constantly at work on all of them—in this Army, Navy and War industry may have the light they need—and have it now!



G-E discovery of a new phosphor helped development of RP-12 just as other discoveries improved fluorescent lamps for industry. This device sets phosphor brightness.



These lamps make instrument more from upper eye used in G-E MAZDA fluorescent lamp. Result: quicker starting and improved efficiency. One of G-E quality controls.

These girls are inspecting G-E Maytag fluorescent lamps during a "sanitizing" process. Rapid unit production of lamps whether made for industry use, war industry, or the home.

### Free Service to War Industry

WAR PLANT EXECUTIVES PLEASE NOTE!

If you are designing a war plant, big or small, why not find out whether good lighting can help you increase production, cut down rejects, and reduce accidents? Light changes to eliminate glare, gloom, and shadows often make a big difference in production.

Your nearest G-E lamp office will be glad to place a trained Wartime Lighting Counselor at your service. Or call

your local electric service company or G-E MAZDA lamp supplier for advice. Or maybe your problem is to select the right lamps to equip planes, tanks, ships, guns, or other equipment you are making for the Army or Navy. Here, too, G-E lighting men can help you. Ask your G-E lamp supplier or local G-E lamp office—or write to the General Electric Co., Nela Park, Cleveland, Ohio.

G-E MAZDAMPS



GENERAL  ELECTRIC





# CHAMPION SPARK PLUGS

the extreme pressures and temperatures encountered in our latest turbo-supercharged, high altitude aircraft engines have compiled an unequalled record for dependability. Champions are an active duty on every front.



CH—Model

In the pouring cold and needed atmosphere of the sub-sphere, where air supremacy is gained, spark plugs must provide their life-giving sparks under most unusual conditions. To meet these abnormal conditions, exclusive research, specialized engineering and unsurpassing manufacturing standards are combined to give our air force spark plugs with the same characteristic dependability that has made Champion Spark Plugs the standard for earth-bound engines.

Now on active duty on every front, and widely used in engines of every type, Champions are piling up records for outstanding performance, long life and dependability. This is directly due to certain inherent and exclusive

features of design and construction plus special ceramic insulation, with the following exclusive advantages:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "flooding".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Monopoint design eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory return necessary.
7. Scientifically controlled manufacturing.



CH—Standard

**USE CHAMPIONS AND FLY WITH CONFIDENCE**



**W**

aldes Tracore presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly firing circular contour.

For all thrust-load fixing, and shaft and housing applications, Waldes Tracore provides distinct advantages over nuts and bolts or wedges and washers . . . it reduces dimension and weight . . . saves material . . . cuts manufacturing time . . . simplifies assembly and dis-assembly. On request, we will gladly furnish samples and full data for your tests.

**WALDES**

**TRACORE**

**RETAINING RING**

**WALDES KOR-1-NOOD, INC.** **LONG ISLAND CITY, N.Y.**



**MANGANESE BRONZE  
AND DURAL HOSE FITTINGS...**



**...FOR ALL TYPES OF PLANES**



**... DELIVERY IN 30 DAYS**



Am12: 2/20/00, draft, Jan. 2001

Special tooling and 24-hour-a-day operation is enabling us to meet the aircraft industry's increasing demands for Manganese Bronze and Dural hose fittings. We are now manufacturing four types: AN860, 842, 844 and 847, in complete range of sizes. All fittings

except AN890, are pressure tested by air, under kerosene, to 100 lbs. gauge pressure. All tolerances are held strictly to specifications.

Present deliveries are being made in 30 days or less. Subsequent deliveries will, of course, be subject to WFB directives.

Just off the path—how happy I am! I found a small pond, and a small stream. I found a small pond, and a small stream. I found a small pond, and a small stream.



**HARTWELL** AVIATION SUPPLY COMPANY  
AIRCRAFT PRODUCTION PARTS

WEST CARRANAH HILLS - LOS ANGELES - BUREAU TRUNK - BUREAU HILLS - KANSAS CITY, MO

AVIATION, April 1941



### The CONSTELLATION Files

When Lockheed's super-transport, the Constellation, took to the air so successfully she flew with the aid of Pacific-Western pilots.

These are two outstanding developments in this plane—the pressure controlled cabin and the extremely efficient wing shape.

We manufactured the superchargers which normalise cabin pressure at all altitudes in the Constellation and also built the operating mechanisms which move the Fowler flaps on the big plane.

As the Aircraft Industry advances—are kept pace.



We manufacture some of all types for church — Satoh horn, Tani horn, hypoid, worm, cone and ball-and-socket in all sizes and materials.

We also produce water drives: cast with complete with pump and motor, complete with piping or none.

**PACIFIC GEAR WORKS**  
38TH & ROSS ST. LOS ANGELES, CALIF.

Associated Companies: WESTERN GEAR WORKS—Longwood, Calif. • PACIFIC GEAR & TOOL WORKS—San Francisco • WESTERN GEAR WORKS—Seattle, Wash.



**D**irections are vital to pilots. That's easy to understand. But what is not so widely known is this: Aircraft compasses must be regularly adjusted to fight off the magnetic influence of other equipment in the

ship . . . must also be corrected for the magnetic variations found at different spots on the earth. To make these corrections, the pilot must be able to refer to true directions while his ship is on the ground.

The Compass Swinging Sight makes this possible, whether the aircraft be based among Aleutian mountains or deep in a tropical jungle. This device, used principally in the operation of emergency fields,

contributes to hole-line accuracy the points of the compass. It thus makes it possible to correct the instruments on which the safety and success of every flight depends.

Like the other electrical and navigational instruments we are making, the Compass Swinging Sight has a single mission . . . to remove the hazards of guess-work and thus to insure the efficiency and effectiveness of our aerial combat forces.

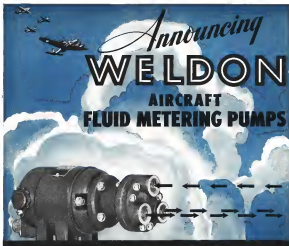
*"Which way's Rangoon from here?"*



The **BOES** Company, Dayton, Ohio

MANUFACTURERS OF ELECTRICAL AND MECHANICAL INSTRUMENTS FOR AIRCRAFT  
50, 750, 100,000! The American aviation industry is performing miracles in mass production, but one step doesn't stop there. We must also lead in the production of the new tools that help to pay for the products we produce. Keep on buying new tools—HERE IS FORGEMAN!

ATTENTION, April, 1943



• For a quarter-century "WELDON" has exemplified quality—accurate—tool work of the greatest precision.

• The skill of WELDON craftsmen in the art of high production manufacture to such limits as one and two "hundredths" is but one reason for the success and acceptance of the WELDON Aircraft Fluid Metering Pump.

• Other compelling reasons are a practical, compact design (pump and motor weight approx. 2½ lbs.) and positive, dependable

performance for such critical functions as sealing protection for propellers, windshields, carburetors, and other vital parts.

• A most flexible feature is the optional provision of one or two outlets.

• Rigid tests thru extremes of altitude and temperature have proven the WELDON Pump dependability under severest operating conditions.

For Engineering Data Sheets, write:

The WELDON TOOL Company - Pump Division - 2848 East 71st Street, Cleveland, Ohio

**THE WELDON TOOL CO.** *Cleveland, Ohio*

ATTENTION, April, 1943



# with real conquest of the air



AIM-40 497

Man's conquest of the air did not end when the Wright Brothers took off at Kitty Hawk. It had just begun. The invention of the flying machine was only the forerunner of a series of other inventions which have together

brought this conquest nearer its goal. Radio communication, born of an entirely different series of necessities, has probably contributed more to the actual conquest of the air than any other independent thing. Knowing where you are and how to get where you want to go in an airplane is almost wholly dependent upon radio. Bringing the great airlines down through "pea-soup" fog is greatly simplified because of radio.

Radio, of course, could not accomplish these things were it not for the invention and devel-

opment of electronic vacuum tubes. Vacuum tubes, of various types, are the heart and soul of radio and every other achievement in the so called science of electronics. Think, then how much credit, for the conquest of the air, is due to the vacuum tubes in the ground stations and blind landing systems now in service. Remember this, too: Vacuum tubes are in the important sections of the ground stations of every major airline.

**BITN-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA**  
25001 SANTA BRUNO & HUNTER, 121 DAY ST. SAN FRANCISCO, CALIF. U. S. A.

Follow the leaders to



## HERE ARE SOME OF THE NEWEST, FAST

## STA-KON TOOLS

for the

## AVIATION INDUSTRY



The T & B Hot-Mark of a perfect installation.

For rapid, automatic installation of T & B small wire terminals and connectors, T & B Sta-Kon Tools are engineered to meet all requirements of any Aircraft Use of Sta-Kon Solderless Terminals. Made to operate with all types of available power: Manual, Air, Electric or Hydraulic.

Illustrated are a few of these tools designed especially for the Aircraft industry. They stake Sta-Kon Terminals to any size wire and cables  $\pm 22$  to 250 MCM,  $\pm 22$  to 4.0 Aircraft.

- ① **Hydraulically operated.** Complete unit. Can be attached to various types ground planes. For large size Sta-Kons.
- ② **For small size Sta-Kons.** Air operated. Ideal for high speed production.
- ③ **Also for fast bench installation of small Sta-Kons.** Operated by air. Makes perfect connections.
- ④ **Handly operated hand tool.** For regular use do hand to get in location. For small Sta-Kons.
- ⑤ **Hand tool covering tremendous pressure.** Warning available for bench operation. For middle-range Sta-Kons.
- ⑥ **At-line hand tool.** Especially useful for emergency repair work. Light weight.



Write for full data on complete line of Sta-Kon Tools

## THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH, NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal





THE GENERAL MANAGER ASKED:

*"Why change to  
Ozalid  
Whiteprints?"*



**YOU CAN COUNT ON** the General Manager firing a line of questions when radical changes are suggested.

Here are three questions frequently asked by hard-thinking, hard-boiled executives when the engineering department propositions an Ozalid Whiteprint Machine. And here are some sound reasons why so many have been convinced of Ozalid's superiority over old-fashioned print-making methods.



**Q. What's wrong with our present equipment?**

**A.** Compare with Ozalid's. An Ozalid machine turns out whiteprints of engineering drawings, charts, letters in two

fast steps—EXPOSURE and DRY DEVELOPING. There are no liquid baths, no plumbings connections, no solutions to mix. A score of other maintenance headaches have also been eliminated.

And, an Ozalid Whiteprint Machine is so clean and compact... it may be installed right in the drafting room. Anyone can operate it at top efficiency.



**Q. Why is the Ozalid Process the most versatile?**

**A.** You can do so much more! (a) You can make prints having black, blue, or even lines on a white background. The reason for this is considered for the shop where it shows the greatest contrast to grease and dirt... and will stand up better than the white line of a blueprint. (b) You make duplicate originals the same way you produce standard prints—without the Dye Image. (c) You can

use cut sheets as well as roll stock in an Ozalid machine. Thus, you can completely eliminate the costly waste of large sheets the size of your linings.



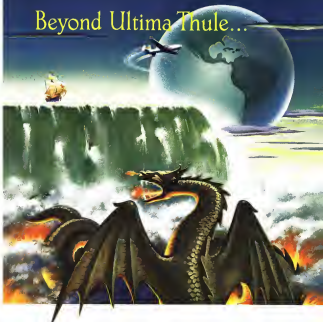
**Q. How can Ozalid save a thousand hours in our drafting room?**

**A.** Give a draftsman an Ozalid duplicate of a tracing which you want changed in part. He'll have a "new" original in a fraction of the time required with other methods. First, he erases the obsolete lines with Ozalid Corrector Fluid. Then he draws in the new design. It's that easy! It's now necessary to redraw any line which remains the same as in the original.

Think of the changes you're making in your products today. Think of the changes you'll be making in the post-war period. By installing an Ozalid Whiteprint Machine—you'll be sure of a "head start."

Write for "Simplified Printmaking." It shows how to make master-plates from blue, black, and materials with the Ozalid Process.

Beyond Ultima Thule...



WHEN the ancients believed the earth was flat, *Ultima Thule* was the unexplored—the unknown at the remotest edge, where the sea cascaded into space. Until the coming of the airplane on *Ultima Thule* of undeveloped territory and commerce still seemed behind enormous barriers of time and distance. Today's strength have passed those frontiers... tomorrow's transports will reach beyond, making the entire world easily accessible to all.

LIGHT • ISHANT POWERFUL

**Wright**  
ENGINES

**OZALID PRODUCTS DIVISION**

GENERAL ANILINE AND FILM CORP.

Johnson City, N. Y.

WRIGHT POWERS THE TONNAGE OF THE AIR





#### Saver of Precious Metal

Because Boots Self-Locking Nuts are lighter, they save hundreds of tons of strategic metal. The Anchor Nut (shown in cross-section above) is the type of Boots Nut most commonly used on military planes. It operates on the familiar Boots self-locking principle. The flange of the top locking section fits tightly out of phase with those of the lower, load-carrying section. When the bolt engages the locking section, a constant pressure is established which prevents any loosening due to vibration.

#### Here's More Fire-Power to You, Sergeant!

The lighter the plane, the greater can be its fire-power. Every pound saved in airplane construction therefore becomes a vital factor in winning the war.

Planes of all types, from the greatest four-engine bomber down to the small pursuit or trainer, are made with Boots all metal, self-locking nuts. On a heavy bomber, this means a saving of more than sixty pounds—enough for 200 rounds of .50 caliber machine gun bullets.

Boots all-metal nuts are not only lighter, but literally "outlast the plane."

Specially developed for mass application, the new Boots "Nut-Tap" Self-Locking Nut is winning a wide acceptance among engine manufacturers.

# BOOTS

Self-Locking Nuts For Airplanes in the All Industries

BOOTS AIRCRAFT NUT CORPORATION • GENERAL OFFICES, NEW CANADA, BRUNSWICK

# TOOLS

that keep pace with aircraft progress . . . . .



Knowledge of aircraft construction and maintenance guides the design of *Aircraft* TOOLS...and makes them fit each specialized job most efficiently. Constantly improved to meet new demands, these tools are accurate, rugged and easy to use... they speed home front production and battle front maintenance.

Write for free new 1943 catalog of *Aircraft* TOOLS...on company letterhead, please.



FOREIGN REPRESENTATIVES—

The A. R. Williams Machine Co., Ltd., Toronto, Kingston and Vancouver, Canada; The Canadian Fabricating Works Co., Montreal, Canada; H. G. Gould & Co., Long, Melbourne, Australia; H. W. Smith & Sons, Ltd., London, England; H. G. Gould & Co., Ltd., San Francisco and Los Angeles, U.S.A.; W. A. Dwyer, Ltd., Honolulu, Hawaii.

AVIATION, April 1943

71



**"... we fight our country's battles  
in the air, on land and sea ..."**

High over the Solomon ... Marines and Grumman "Wildcats" are making history. The headlines show the score!

The ability of the "Wildcat" to dominate the other fellow's air ... to stand the strain of carrier service and scratch maintenance of jungle airfields ... is merely more evidence of Grumman's ability in designing and building outstanding ships for specific services. In war or in peace, look to Grumman to set the pace.

**GRUMMAN . . . . .**  
MAKES PLANE THAT MAKE HISTORY



GRUMMAN AIRCRAFT ENGINEERING CORPORATION • BETHPAGE • LONG ISLAND • NEW YORK

**The \*GENERAL\* G-3000**  
*rivets sections in*  
**LESS THAN AN HOUR**  
*that used to take ALL DAY*

Speed and more speed is the cry! In the air! On the production line. General Engineering designers are answering the call for more air speed. Now the \*General\* G-3000 Automatic Multiple Riveter smashes the time-table of the production line. It achieves REALLY high speed riveting.

Wing spars and huge wing sections are through the machine automatically on automated turn rolls. Two pairs of revolving arms bend two groups of from 6 to 15 rivets each simultaneously as automatic controls bring the work into position. Wing sections that formerly took 8 skilled men all day to rivet by other methods, roll through the G-3000 in less than an hour.

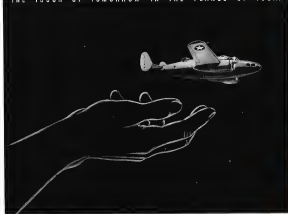
Ask us for complete information on this revolutionary development in aircraft fabrication.



**\*GENERAL\* Engineering Company**  
1000 WASHINGTON AVENUE, NEW YORK, N.Y.



THE TOUCH OF TOMORROW IN THE PLANES OF TODAY



Continued on p. 14

## Fairchild Perfects a Plane to Speed Advanced Training

The new Fairchild AT-14, a twin-engine advanced trainer designed for quick production from non-strategic materials, is a product of Fairchild engineering versatility—a versatility gained through extensive aeronautical research and the application of experience to the creation of airplanes for specific missions in this war.

The AT-14 is of Fairchild Dornedorf plastic-bonded plywood construction throughout. It is the first trainer of its type with triplex landing gear. It accommodates pilot, co-pilot, bombardier, navigator/radio operator and gunner and contains all

instruments required under all conditions of a long range bombing attack. It is powered by two Fairchild Ranger Twelve air-cooled, in-line inverted engines. In every phase of its design and construction it bears the unmistakable Fairchild "Touch of Tomorrow."

**"ON THE MARK"**  
"The dominating note of our aviation war effort is unity, unity of our people and unity of the United Nations. That is the heart force which is the guarantee of Victory."  
—Franklin D. Roosevelt  
(From letter dated December 22, 1942 to January 4, 1943)

Coming Fairchild achievements in implementing our war in the air will further reflect Fairchild engineering versatility. They, too, will bear "The Touch of Tomorrow"—for the advancement of aeronautical science and for a more certain Victory in the air.

**Fairchild Aircraft** Division of Fairchild Engine and Airplane Corporation, Hagerstown, Md.

AVIATION, April 1943

## PROTECT HIS ATTACK!

• Cowl Fastener efficiency is vital to aircraft performance and the exclusive advantages of Shakeproof Cowl Fasteners assure the extra holding strength so essential under the excessive strains of battle action. Aviation designers and production men are invited to write for Shakeproof Catalog AD-2 which gives complete technical data and procurement information regarding the better cowl fastener.

### SHAKEPROOF COWL FASTENERS

**REINFORCES STRUCTURE**  
Stress fasteners load concentration and danger of distortion eliminated by reinforcing beam.

**LIMITED DEFLECTION**  
Four beam fasteners provide support, limiting deflection of bridge to predetermined value.

**FAST, EASY ASSEMBLY**  
Only 3 parts—going with stud and screw pin. Only one special tool (stud pin) required.

**QUICK POSITIVE LOCKING**  
A quarter turn with screw driver locks it tight. Ideal for field servicing—quickly replaced.



Shakeproof Cowl Fastener Assembly in locked position.

AVIATION DIVISION

**SHAKEPROOF inc.**

*Fastening Headquarters*

3801 Meigs Center Avenue, Chicago, Ill. 60640  
Soleholders of Shakeproof Products Manufactured by SHAKES TOOLS WORKS  
Plant at Chicago and Rock, Illinois  
In Windsor, Canada (Hwy. 70) 1000 Mainville, Toronto



## The Jeep Learned to Steer by Watching the Printing Press

IT'S THE OPENING operation hour after hour in a printing press—an hourly breakdown that might delay the newspaper as its way to the waiting delivery trucks. So printing press makers pulled the Torrington Needle Bearing for its ability to operate successfully in high speed service, with little need of attention.

There's no question of high speeds in the increasing volume of a jeep, of course... just an occasional turn through a fraction of a revolution. But that point of long life with little attention looked just as good to the jeep builders as it

did to the press manufacturers. They, too, turned to the Needle Bearing, not only for its ability to stand up in service service, but for its low friction coefficient that gives quick response to the steering wheel, its small size that contributes to compact designs, its effective system of lubrication, its ready availability for all essential applications.

HERE'S A THOUGHT FOR YOU TO CONSIDER when you start the design of your power products. Whether your problem is one of oscillation or of high speed rotation, the Torrington Needle Bearing will give your customers the advantages

of dependable operation, efficient lubrication, low starting and running friction. And of course, you will benefit by the Needle Bearing's low cost and ease of installation. You can get the preliminary information you will need by writing for Catalog No. 114, which lists sizes, notes, and typical applications—and Torrington engineers will meet you in working out specific service problems.

**THE TORRINGTON COMPANY**  
Industrial Unit - Torrington, Connecticut U.S.A.  
Divisions of: Health and Safety Bearings  
New York, Boston, Los Angeles, Dallas,  
Chicago, Seattle, Oklahoma, San Francisco,  
San Antonio, Toronto, London, England



## TORRINGTON NEEDLE BEARINGS

KEYED TO TODAY'S NEEDS  
AND TOMORROW'S DEMANDS



## "Freeze" DIMENSIONS ON GAUGES AND PRECISION PARTS

**increased production**  
Case Study from the Files of Deepfreeze  
The Six-Term Method  
of Shrinking, Treating and Treating of Metals  
\* How to improve in long time



Typical gauges subjected to alternate cold and heat treating

### DATA AND PART INFORMATION

Shrink gauges in several changes to fulfill the  
Shrink gauges treated as follows: 1. 2 hours Deepfreeze  
3 hours boiling water — 2 hours Deepfreeze  
Other gauges treated according to gauge and steel  
Some are heat treated in a steel plate or stainless  
between non-binding conditions. The dimensions number  
of Deepfreeze application — longer gauges shrink more  
than one.

- Sequence of Operations on Shrink Gauge:  
1. Methodical heat treatment and rough ground  
2. Deepfreeze and heat treat  
3. Finish by tapping.

**RESULTS:** Gauges hold size to within 0.0001 inch's  
precision — no rejects

**SAVINGS:** All one previously had to accept in re-  
peating gauges where size was distorted due to temper-  
ature changes and jacking.

**FREE ADDITIONAL DATA...**  
and proof of the outstanding  
results of the Deepfreeze  
method for shrinking metals  
are included in this book-  
let. Write for your copy.



## Customers of Gauge Manufacturer Now Receive Gauges With Exact Dimensions as Shipped

This prominent manufacturer of gauges experienced difficulty in producing growth or change to size of gauges during shipment to customers, and during here were customers' plants. Jarring and temperature changes in transit affected finished gauges and loss of careful work must be wasted. When gauges were not distorted in transit, future steel growth and warp resulted in special work to the customer's plant.

## Alternate Cold and Heat Treating Assures Correct, Permanent Size

With the installation of Deepfreeze Industrial Chilling Equipment, experience with used lost treatment, the gauges are now properly treated to hold finished size under all seasonal temperature changes and handling.

Gauges are stored 2 hours in Deepfreeze unit, then in boiling water, oil, or air, both depending upon steel used, and then back to Deepfreeze storage for 2 additional hours.

## The Uses of DEEPFREEZE in Your Plant

In addition to producing growth or warp in gauges and precision parts, Deepfreeze metal chilling can help you to:

- 1—Shrinking of metals for ease of bending assembly, etc.
- 2—Treating of joints for removal of sub-zero components to aircraft engine parts, etc.

Investigate the full possibilities and application of Deepfreeze in your manufacturing... write for the booklet offered at the left

# Deepfreeze

DIVISION

**MOTOR PRODUCTS CORPORATION**  
2312 DAVIS ST., NORTH CHICAGO, ILLINOIS



# CLECO

## SHEET HOLDERS

Why the **ORIGINAL** Sheet Holder Offers You the **FINEST** Service:

1. Saves 60% of time ordinarily required for securing sheets prior to riveting. Eliminates use of holding screws or bolts.
2. Exerts 50 lbs. of even clamping pressure—no buckling or distortion—no loosening due to vibration of riveting.
3. Different color for each size facilitates identification, speeds up insertion.
4. Access to only one side is necessary for insertion and removal.
5. Locking stem has correct diameter for rivets being used—no drilling or reaming.
6. **EXCLUSIVE REPAIR AND EXCHANGE SERVICE.** Damaged sheet holders can be sent to our plant or branch office repair stations for prompt repair at nominal cost. Exchange stocks also available at these repair stations.

Write for Bulletin 87, THE CLEVELAND PNEUMATIC TOOL COMPANY, 3750 East 77th St., Cleveland, Ohio. Branch offices in all principal cities.



Cleco Sheet Holders being used on a Nose Web



★ BUY U. S. WAR BONDS AND STAMPS



Cleco Sheet Holders on a Fuselage Assembly in Bay



"Clecoing" an Airplane Wing



## FLYING FURY..

### Making Scrap in Africa!

POTENT instrument of destruction is the U. S. A. F.'s Martin "Baltimore" medium bomber, as the Nazi Afrika Korps discovered to its consternation.

In the building of this, and others for the U. S. Army and Navy and for Britain, The Glenn L. Martin Company is pioneering new developments that hold high promise for the postwar world of peace. "Martinizing" is giving America new discoveries in plastic, synthetic rubber, the light metals... uncovering new theories of design, new production

tools, new methods of speeding industrial output.

These Martin wartime developments will play a vital role in giving America the greatest commercial aircraft ever envisaged. Already giant over-ocean striders of 125 tons be ready-to-build on Martin drawing boards... while others of 200 tons and up, embodying even more spectacular developments, are in the planning stage.

Martin is ready, as soon as peace gives the green light, to help bring wings to the world!

THE GLENN L. MARTIN COMPANY, BALTIMORE, MD., U. S. A.

Beyond the War's End



Then there are those in the battle front and the home front, a great post-war world is being built... a world of new dimensions, new objectives. For instance, Martin has done for great numbers of 125 tons... in placing ordered 200 tons and up. These are aircraft that will bring the whole world within reach of your service... ships that will build for a truly permanent peace by making it more tangible. Be war or in peace keep your eye on the Martin fleet.

**Martin**  
AIRCRAFT

Division of Dependability Through Good Design

Member, AIRCRAFT WAR PRODUCTION COUNCIL, EAST CHASE, ILL.



# The Gliders are coming

## WITH STOUT RIBS OF STEEL TUBES

**TWO-PLACE TRAINING GLIDER:** Note the long wings. The strain from these is taken chiefly by ten strong tubular spars extending through the fuselage from wing to wing.



**TUBULAR STEEL FUSelage:** gives glider greatest strength with the least weight. All the tubing weighs less than 150 pounds.

**U. S. AIR FORCES** are springing for the tape in the glider race. Gliders save vital materials. They save horsepower and gasoline. And in a war of devices—they save lives.

These two-place gliders are just trainers... but they are a neat job, well done. They weigh only 450 pounds. Vital parts of these sleek planes are made of **REINFORCED SEAMLESS AIRCRAFT TUBING**—to give ample strength for tough maneuvers.

The test pilot cuts loose from about 4000 feet. He dives, rolls, slips, does sharp banks, and even

loops the loop. On one test he took the glider into a tight spin. The long narrow wings jerked at crazy angles. He spun and spun for 13 revolutions, then pulled out at 1500 feet. The glider stood the strain like a veteran.

That's what steel tubing does for gliders, and it puts the same superior strength into the fastest fighters and biggest bombers.

Write for our informative booklet on **SEAMLESS AIRCRAFT TUBING** giving complete specifications for all types of steel aircraft tubing.

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# UNITED STATES STEEL



# Vital as Hell!

Hydraulic systems carry and control the life blood of today's fighting aircrafts—they must not fail!

Dirt, moisture, or corrosion in lines or units—or any damage to threads or tapered surfaces of connecting links will cause failures.

Vital Tubing Seal-Caps, Seal-Plugs, Flex-Caps, and Boss-Plugs completely protect hydraulic lines and unit fittings in all stages of assembly prior to flight.

Where others might chip or be sucked into line metal Tubing Seal-Caps and Plugs have no particles to chip off and enter tubing—can be re-used many times—do not deteriorate—are not affected by contact with chemical agents—can be installed in much less time than other devices.

Write today, for the new file-size booklet, "Tubing and Pipe Protection Methods," describing these vital products.

## TUBING SEAL-CAP, INC.

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Used by Douglas, Boeing, North American, Republic, Vought, Lockheed, Martin, Grumman, Bell, and many others.



# Finishing System for Aircraft Engine Cylinder Assemblies



**A Complete Rustproofing and Painting System, Developed by Mahon Engineers, that Shows a 25% SAVING in MANPOWER**

**M**echanization of the processes essential to the finishing of aircraft engine cylinder assemblies is effecting important economies for the aircraft industry. This Mahon installation established a saving of 25% in manpower—38% in production cost.

Previously, much of the work was done by hand. Now—it moves in a steady flow by automatic overhead conveyor through degreaser, rustproofing tank and dip-off oven. From here it is transferred to marking table and thence by conveyor again through 3 painting and baking processes (2 flu-coat and 1 spray painting). Each painting and baking process is a separate operation, yet so skillfully has arrangement and plan of travel been engineered, the flu-coat spinner-type cabinets, hydro-fiber spray booth and the exclusive 3-compartment baking oven occupy a relatively small floor area.

Other similar systems now are in operation—more are in the planning stage. They represent tangible examples of the savings in time, in money and manpower that Mahon engineering and equipment is accomplishing in the aircraft and other vital industries where finishing and processing operations are an important part of production.

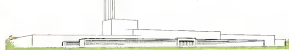
These built-in-the-job  
finishing systems are  
designed, erected and  
operated by Mahon  
Engineers, Inc. in  
factories, shops, and  
other industrial plants.  
They are built in the  
field, or in the shop,  
and are built to meet  
the needs of the  
customer. They are  
built to last, and are  
built to be efficient.  
They are built to be  
safe, and are built to  
be economical.

THE R. C. **MAHON** COMPANY  
DETROIT CHICAGO



... going up with the swiftness that makes American industrial construction a war-winning miracle, a vast aircraft plant is taking shape down in New Orleans being rushed to completion by men with the vision to see that there is a quicker way to get to Victory—by going UP. Priceless cargoes for our fighting forces can reach every battlefield safe from Schickelgraber's submarines—by going UP. A huge fleet of Custom Caravans . . . that's your government's initial order to Higgins Aircraft, Inc. And before the birds begin their winning near New Orleans, the fleet of these cargo-carrying planes will be going up!

HIGGINS AIRCRAFT, INC. NEW ORLEANS











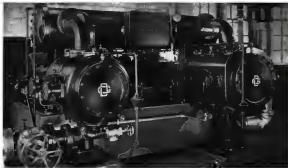
## The story of its success is written in cost ledgers

**G**ARDNER-DENVER "HA" Two-Stage Horizontal Compressors are writing a success story in the cost ledgers of many a successful plant.

Engineered for continuous heavy-duty service, they have a high compressive efficiency which is assured by such features as unrestricted air passages and large valve areas. Their greater air capacity is under constant, automatic control—is regulated to fit your air needs.

For extra strength and durability through the years, frame, cylinders, pistons, and other vital parts are cast of GarDurloy—the stronger, tougher cast iron developed by Gardner-Denver. Timken main bearings provide smooth, trouble-free, economical operation; seldom require adjustment.

For further information on Gardner-Denver "HA" Two-Stage Horizontal Air Compressors, write Gardner-Denver Company, Quincy, Illinois.



**GARDNER-DENVER** Since 1859



AVIATION, April, 1946



## ETHOCEL PLASTIC—

*Tough, Durable—and Light!*

These characteristics, which have made Ethocel a valuable plastic material for window frames and other parts, indicate its use in solving many future aircraft problems.

In the application illustrated here, extruded Ethocel is used for aircraft window frames. Perfect finishing of the finished part is assured by these Ethocel characteristics: 1. Toughness—Ethocel is tough and strong. It resists shock stress and vibration. 2. Retention of Properties at low temperatures—Ethocel possesses unusual resistance to impact at zero. 3. Durability—Ethocel is not susceptible to internal breakdown and embrittlement with age. 4. Dimensional Stability—Ethocel is not subject to shrinkage due to moisture loss. 5. Light weight—Ethocel is the lightest of the commercially available cellulose plastics. Weight of a cubic inch of Ethocel is .55 or—a significant loss in all aircraft applications.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • St. Louis • Chicago • Boston • San Francisco • Los Angeles • Seattle

**ETHOCEL**

DOW PLASTICS

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CHEMICALS INDUSTRIES  
TO INDUSTRY AND AGRICULTURE



# MERIAM INSTRUMENTS

## *on the March*



★ Possibly Meriam Instruments can serve you, too, as they are serving others on both the war and home fronts.

Right now, of course, Meriam Instruments are taking these part in the war effort. They are on the march to victory.

Out of America's huge war effort will come new products, and new economies. This is the future we are looking toward—and planning toward—the time when Meriam Instruments will march toward a better world.

So, when the right time comes, you may be able to use the resources and skill of this organization as products for peacetime requirements, involving measurement of pressures, vacuums and differentials. We trust you can adapt our long experience to your needs most advantageously and profitably.

*For description of Meriam Instruments visit the Catalog C-10*

**THE MERIAM COMPANY**  
1933 West 112th St. Room 2021 Cleveland, Ohio

**MERIAM — THE INSTRUMENT PEOPLE**

## THESE MAJOR ADVANTAGES MAKE

# Tego Resin Film

### THE UNIQUE AIRCRAFT PLYWOOD ADHESIVE

**P**lywood bonded with Tego Resin Film is literally fused to a new material having unique characteristics.

Tego-bonded plywood is the accepted standard for aeronautical plywood meeting the rigid U. S. Army and Navy Specification AN-NP-511-B.

Tego-bonded plywood is fungus-proof—the bond is unaffected by sun and weather.

Tego-bonded plywood meets service requirements. It's completely waterproof—without hours of submersion even in boiling water.

Tego Resin Film is a precision adhesive insuring uniformity of spread and complete control of manufacturing conditions. Plywood bonded with Tego is weight-for-weight stronger than steel.



*Hand applies resin film to plywood before being hot-pressed into a fungus-proof, weather-proof panel.*

### THE COMPLETE LINE OF RESIN ADHESIVES



**TEGO RESIN FILM**, for hot-pressed plywood, produces the most durable plywood known, fully meets the requirements of Army-Navy Aeronautical Specification AN-NP-511-B.

**ABERLITE PH-11** is widely employed for rubber bag making, plywood filling, etc. and for a pin-board phenolic resin adhesive which possesses extreme water resistance and durability.

**UFORWITE CR-551**, a powerful cold-setting resin, furnishes a resin composite in all respects with Army-Navy Aeronautical Specification AN-61-B, has proved an ideal bonding agent in assembling plywood stressed sections.

**UFORWITE 430 AND UFORWITE 500**, for rubber bag pressure or cold setting plywood, give remarkably strong bonds at relatively low cost.



*Resin Transfer pressing in resin plant—Achesonite, sturdy panel of plywood, bonded with Tego Resin Film.*

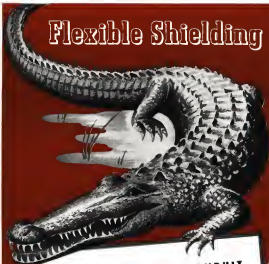
## THE RESINOUS PRODUCTS & CHEMICAL COMPANY

3401 EIGHTH AVENUE, PHILADELPHIA, PA.





# Flexible Shielding



## BREEZE SHIELDING CONDUIT ... Tough, Flexible, Long-lived

**B**REEZE Flexible Shielding Conduit is being produced in ever-increasing quantities for the fighting forces of the United Nations. Used in conjunction with Breeze Plating, this Flexible Conduit is designed to meet varied shielding requirements in installations ranging from PT boats to aircraft. From its background of years of experience in the field, Breeze has acquired the knowledge to solve shielding problems of all kinds — knowledge which is reflected today in the high standards of Breeze design and manufacture.

**BREEZE CORPORATION, INC. • NEWARK, NEW JERSEY**



Out of the mist, the torpedo bomber strikes! The majority of American ship-board planes . . . fighters, dive bombers and torpedo planes . . . are protected with Berryloid aircraft finishes. Perfected

through years of intensive laboratory research and carefully controlled through every step of their production, Berryloid aircraft finishes provide maximum protection against extreme exposure conditions.

## BERRY BROTHERS, INC.

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

BOSTON • JERSEY CITY • CINCINNATI • CHICAGO • ST. LOUIS • INGLEWOOD, CALIF.

MONTREAL • WINNIPEG • TORONTO

# BERRYLOID

## AIRCRAFT FINISHES







Down—but not out of action—is this long-range patrol bomber of the U. S. Navy. These aircraft, equipped with Lawrence Auxiliary Power Plants, possess a dependable source of electric power to operate radio, lights, and heating equipment even when main engines are dead—power to call for help and to keep the crew warm and comfortable until it arrives.

Lawrence Auxiliaries today serve America on the sea and in the air, providing power for necessary equipment of all kinds, from gritty hot plate to main engine starters. The efficient and reliable performance of lightweight and compact Lawrence Auxiliary Power Plants is playing an important part in America's combat operations on world-wide battle fronts.



Lawrence Auxiliary Power Plant,  
Model 20D

**Lawrence** AUXILIARY POWER

LAWRENCE ENGINEERING AND RESEARCH CORPORATION • LINDEN, NEW JERSEY

AVIATION, April, 1943

## Air Power Through Piston Rings

**McQUAY-NORRIS**  
ALTIMIZED  
**PISTON RINGS**

**PISTONS... PINS...  
HARDENED AND GROUND PARTS**



Wherever planes are flying, McQuay-Norris precision parts of un-failing strength help them perform more efficiently and with greater durability. More and more, the aviation industry is availing itself of our 33 years' experience in making precision parts, our metallurgical research, our engineering and technical facilities. We are now direct contractors to the Army and Navy and sub-contractors on precision parts for aircraft, tanks, scout cars and trucks. Your inquiries are invited.

**PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM**



**McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U.S.A.**

CANADIAN PLANT, TORONTO, ONTARIO

PARTS FOR  
AIRCRAFT ENGINES  
Piston Rings  
Oil Sealing Rings  
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Carburetor Parts  
Machined Aluminum Pistons  
Piston Pins  
Counterweight Check Pins  
Machined Magnesium Parts  
Cylinder Head Down Nuts  
Hardened and Ground Parts

PARTS FOR  
PROPELLER ASSEMBLY  
Machined Magnesium Parts  
Piston Rings

EQUIPMENT FOR  
MAINTENANCE OF AIRCRAFT

Pistons for Oxygen  
Compressor  
Piston Rings for Oxygen  
Compressor  
Pins for Oxygen Compressor  
Pistons for Air Compressor  
Pins for Air Compressor  
Piston Rings for Air  
Compressor

LANDING GEAR PARTS

Machined Aluminum Pistons  
Piston Rings  
Hardened and Ground Parts









## MULTIPLICATION

★ In the month of December 1944, the United States was attacked by enemy. In anticipation of such a possibility, our Government had created a Defense Program. Under the Defense Program, by December 1944, the production of the Beech Aircraft Corporation had multiplied 12½ times over the production rate of the year 1939, when Hitler first unleashed his fury.

With war a reality, efforts were redoubled, and by December 1944 the production rate of the Beech Aircraft Corporation had reached the astounding level of more than 400 times the average production rate for the year 1939.

That story, repeated all over the United States, for all sorts of weapons of war, is the story of disaster for the Axis aggressors.

### Comparative Rate of Beech Aircraft Production

Year 1939	1	2	3	100%
December 1941	1	2	3	1,250%
December 1944	1	2	3	12,500%

A Beechcraft AT-10 Drops a Bomb of Death

# Beech Aircraft

CORPORATION

BEECHCRAFTS ARE DOING THEIR PART



WICHITA, KANSAS, U. S. A.

# NOW Class 9300 Circuit Breakers 5 to 125 Amperes

for use in Aircraft, Tanks, Boats, and other mobile equipment

**CLASS 9300  
5-125 AMPERES  
29 VOLTS D. C.**



APPROXIMATE  
RATING  
10, 20, 100 and  
125 Amperes



TYPE ON  
Toggle Switch  
mandatory "ON"

TYPE C  
Toggle Switch  
only

TYPE A  
Toggle Switch and  
Circuit Breaker with  
Trip Indicator

Class 9300 small, bakelite-enclosed circuit breakers provide "ON" and "OFF" switching as well as circuit overload protection. The combination of toggle switch and circuit breaker in a single sealed unit saves weight, space and wiring time. These devices may be used for direct control of electric motors, lighting circuits, communication and signal systems, or fire control installations. Although designed primarily for aircraft use, they are also suitable for boats, tanks, tunnels and other mobile units having up to 29 volt D. C. power supplies.

Each breaker is calibrated and factory-sealed. There are no field adjustments—nothing to temper with. After tripping, there is nothing to crumple—merely move toggle lever to "ON" position.

### ALL TYPES AND SIZES OF CLASS 9300 CIRCUIT BREAKERS HAVE THESE FEATURES

- ★ **Non-Trip Free.** Breakers may be held closed in an emergency.
- ★ **Acceleration Tested.** Acceleration force of 10 G's does not cause malfunctioning.
- ★ **Vibration Tested.** Breakers withstood up to 55 cycles per second at 1/12 amplitude (1/16" total excursion).
- ★ **Ambient Temperature Range.** -50° F. to +125° F.

**SQUARE D COMPANY**

DETROIT-MILWAUKEE-LOS ANGELES  
BOLLSMAN INSTRUMENT DIVISION, ELKHART, NEW YORK  
IN CHARGE: SQUARE D COMPANY DIVISION LIMITED, THAMES, ENGLAND





## HOW TO SELECT THE RIGHT RELAY FOR YOUR CONTROL PROBLEM

For any electrical control problem, it is easy to find a relay that "will work." But that isn't good enough. You want the one combination that will exactly fit the conditions of your problem, and give you the longest, most dependable service at lowest cost. You can get it by taking these two simple steps:

First, get your copy of the most complete handbook on the subject ever published—the Automatic Electric catalog of electrical control apparatus. In it you will find out the most basic types that will fit your conditions.

Then, if you want competent help in determining the exact coil and contact combination you need, call in our field engineer. He knows from long experience with such problems as yours which particular combination will serve you best.

Follow this dual guide and you can't go wrong, for when you select Automatic Electric relays, shopping

switches or other control devices, you not only get products of proved dependability; you benefit also from the engineering technique that created the dial telephone system—the world's most outstanding example of the application of electrical control to a basic need.

Write today for your copy of the catalog—or simply ask our field engineer to bring one over.



**AMERICAN AUTOMATIC ELECTRIC SALES COMPANY**  
1033 West Van Buren Street, Chicago, Ill.



## MAKER OF WINGS

He's one of the nation's very busy of war workers. You know someone just like him. Steady, reliable—an all-American, average man.

Yet in his hands he holds a precious gift—the capacity to make man's age-old dream of flying an everyday reality. He is one of America's makers of wings. He builds planes . . . army and navy aircraft that battle and fight and win. The tools he uses must be dependable and efficient. Just as thousands like him, this worker has learned

that he can rely on Williams' Tools implicitly. He uses them with pride and ease—for he knows that good tools are essential if he is to perform his war job successfully.

**WILLIAMS**  
MAKING THE DIFFERENCE

**DROP-FORGINGS & DROP-FORGED TOOLS**  
J. W. WILLIAMS & CO., BUFFALO, N. Y.



*Compressors, too,  
are working hard these days—*

**PROPER LUBRICATION IS  
MORE IMPORTANT THAN EVER**



Built into Chicago Pneumatic horizontal stationary compressors are force feed cylinder lubrication and a highly efficient flood system of frame lubrication. These lubricating systems require only minimum attention on the part of the operator—a few simple check-ups which, however, should be made regularly.

Additional suggestions for maintaining compressor efficiency will appear in future advertisements. Watch for them.

**HOW TO GET MAXIMUM OPERATION FROM YOUR CP COMPRESSORS**



Bearings will not run without oil. Keep oil in crank case at level indicated on oil level gauge illustrated. Drain, clean, refill reservoir at least once a week—more frequently if local conditions require.

At least once a day, check the force feed cylinder lubrication, making sure reservoir is filled to required level. Make certain that lubricator is feeding only the number of drops per minute recommended for your particular size of compressor—too much oil results in carbon formation and overheating.

\*\*\*\*\*  
PNEUMATIC TOOLS  
ELECTRIC TOOLS  
(Hydraulic—Universal)  
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**CHICAGO PNEUMATIC  
TOOL COMPANY**

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AIR COMPRESSORS  
VACUUM PUMPS  
PISTON ENGINES  
HYDRATION ACCESSORIES



*Back in Action...THANKS TO WINGS*

Evacuation of the wounded by air—suits drugs... blood plasma. These three many miracles of the war are making possible the greatest number of recoveries in the history of human conflict! We are proud and grateful for the major role Douglas Skytwin, Skycopter and Skymaster transports play in this life saving drama. Douglas airplanes on every front are daily flying troops and supplies into battle, then returning the wounded to base hospitals in time.

Douglas Aircraft Co. Inc., Santa Monica, Calif.  
Long Beach • El Segundo • Tulsa • Oklahoma City • Chicago

**WINGS OF MERCY AS WELL AS WAR**



C-54 "Skymaster" C-47 "Skytrain" A-20 "Havoc" B-26 "Invader"  
C-37 "Skycoach" A-1H "Havoc" A-24 "Liberator"

**DOUGLAS**

Largest Builder of Cargo and Transport Aircraft

MEMBER, AIRCRAFT MANUFACTURING ASSOCIATION, INC.





## "BENDIX" LANDING GEAR

"BENDIX-PNEUMATIC" Shock Struts and "BENDIX" Wheels and Brakes are important members of "The Invisible Crew" of precision equipment which 25 Bendix Plants from coast to coast are speeding to world battle fronts.

### For SAFER take-offs and landings

Getting heavily loaded bombers, cargo and troop transport ships safely into the air and in bringing them safely down again, "BENDIX" Landing Gear plays a vital part.

Precision-built "BENDIX-PNEUMATIC" Shock Struts, combining compressed air and hydraulic controls, quickly absorb both the minor vibrations and shocks of rough terrain in take-offs and the terrific impacts which are inevitable in landing heavy planes at high speeds.

"BENDIX" Wheels and Brakes have ample reserves of strength and exclusive features that assure fast, but smooth, corking of the plane's speed. The safety of "BENDIX" Landing Gear is available for any plane. As new planes are introduced, Bendix engineers will gladly design adaptations for each model.



**BENDIX PRODUCTS DIVISION**

of Bendix Aviation Corporation  
South Bend, Indiana

## Food—The Deciding Issue

*Our food problem remains to be solved*

THE first thing the Germans did when they occupied Czechoslovakia, Poland, Belgium, France—was to empty all warehouses. Everything went into trucks headed for Germany.

The Nazis knew that this was bound to be won by the army that had the most supplies and the best supply system.

The Nazis knew that supplies are so essential in war. They knew that the most essential of all supplies is... food.

Being the only people on earth who can watch seasons and harvest time, the Nazis based upon food in their most powerful instrument for accomplishing the mission. They added famine to their arsenal of conquest.

The facts and heads of Europe are being consumed with starving rapidly. The desperate shortage of meat and fish is growing steadily worse. One Allee is short of certain foods that we must supply if we expect them to carry on.

And as we supply them, as the supplies are cut off, as our fighting men consume more than they do in civil life, and as we fail to increase our production rapidly enough—we, too, become short of certain foods.

Former President Herbert Hoover, speaking before a conference of the Governors and Representatives of twelve Mid-Western farming states in Des Moines on March 19th, sounded the warning that American agriculture, beset by widespread bankruptcies, no manure, farm machinery and power systems, struggling production and distribution, is facing a devaluation which may bring on a national food shortage such as led to the collapse of Russia, the defeat of Germany in the first World War and the fall of France in the present war. Unless this devaluation is stopped, warns Mr. Hoover, we cannot hope to win the present conflict.

Complications of similar magnitude face the food processor and the distributor.

Never in the history of the world has man's dependence on food been so crucial. Yet it is not even for us to grasp the full significance of the crisis. We are so accustomed to finding milk, eggs and butter on our doorsteps every morning, we are so used to filling our pantries from the shelves of our grocers and markets that we accept food as something that is due to us on demand. We do not stop to think that we never see more than a few months' stock of food.

But this picture has changed. Now we are faced with

food shortages, and every day the shelves of our food markets become more bare.

Let it be noted that the appointment of two Food Administrators has not solved the food problem. It is still with us, daily it becomes more critical. Unless it is solved, and solved quickly, the very food that our Food Administrators for War and Peace "win the war and win the peace" may lose the war and lose the peace.

Put very simply and clearly, the food problem amounts to this: we are trying to feed 200 million people. We are trying to do it with the farms and other facilities that heretofore have been capable of feeding about 145 million people (our present population plus a 5% surplus).

If the Government foresees the need and planned ahead, we could have begun by 1941 the enlargement of our farm production and food processing capacity. Two inoperable years have been lost.

The growth of the situation becomes apparent when we consider that 78,000 factories are required to process our food. Food processing not only is America's biggest industry—it is one of America's most important too, without processing, most foods would perish before they could reach the consumer. The term "processing" covers the salting, drying, canning, pickling, churning, creaming, packing and other methods of preservation that make it possible for us to eat in 1943 food that was produced in 1942. Few realize that more of the food we shall eat in 1943 was produced and processed last year, that most of the food we plan this spring will grow and be processed in 1944 or perhaps later.

In one important process of preservation, fat and rubber are vital materials. When the Japs captured Malaya and the Netherlands East Indies more than half of the world's fat and nearly all of its rubber fell into their hands. This forced drastic changes upon our entire food economy. The importance of tropical food commodities, like fat and rubber, is a daily classroom mental food containers alone consume, every year, more than 2,700,000 tons of steel.

The aggression of Japan has caused our whole food industry a state of extreme packing problems. It has retarded recognition of a new principle of food technology, i.e., that the method of food preservation is determined by the type of container available. The tin, steel and rubber storageage compete with food processors to adopt



valuable methods—methods that call for a great deal of new equipment. This, in turn, underlines the use of critical materials that are so urgently needed for other war purposes.

This conclusion of the food processing industry is based on these existing industries but has greatly complicated by two factors that have increased its wartime burden. Indeed, it is these that provide the potential reason for civilian food rationing.

The first of these is the task of feeding our armed forces overseas. Allied ships are being sunk at an alarming rate and the loss of cargo is considerable.

The second factor greatly augments the first. Under L and Lease we are sending to food to our Allies to the extent of approximately 60 million people.

Types of food required for Lend Lease and the armed forces are the finest we can produce. They are the high protein foods, especially meats, cereals and oils, and the protection foods which are high in vitamin content. Frequently enough, the more valuable a food is from a nutritive angle, the more specialized is the processing required to preserve it.

The food processing industry, handicapped as it is, is meeting today's challenge with determination and efficiency—despite constant complications and shipping shortages.

It is accomplishing its Herculean task by re-inventing and re-inventing a method of food preservation that is as old as mankind. Probably you have read a great deal about dehydrated food. You actually may have eaten dehydrated food, but right now nearly every bit of dehydrated food is consumed for the armed forces or for Lend Lease.

Food processing never will be as spectacular as the production of bombers or tanks that under today's conditions, the performance of the food processor is no less important—no less inspiring. When we consider that dehydrated food is compressed into solid blocks with a density nearly equal to that of steel, so that almost a whole meal can be carried in a vest pocket, and that half of the shipping space is thereby saved as transportation, we begin to appreciate what the processors have contributed to meet the food problem imposed by the war.

But they have not only contributed new methods they are achieving new highs in production. And now they are asked to do what burden on the impossible. Consider dehydrated egg powder. Normal production in pre-war

times was about 7,000,000 lbs. In 1942 this was increased two and one-half times, in 1943 it was stepped up again five times both fold. And in 1944 the call is for nearly 60 per cent more, to make a total of 40,000,000 lb. That's milk powder production of 370,000,000 lbs in 1946, next to be increased to 655,000,000 lbs in 1947.

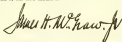
Vegetables, which were a small item to the processor before the war, now are distributed in enormous quantities. The vegetable dehydrated industry has had to grow its beans and beans without benefit of the high protein accorded to semi, ship and aircraft building. Production of dehydrated vegetables in 1942 was four times that of 1941, and 1945 calls for a sixteen-fold increase over 1942.

Total dehydrated food production in 1943 is about 142,179,000,000 lbs, dry basis for all export. Multiply that by 10 and you have a rough approximation of the astronomical amount of raw materials that will have to be produced.

Many problems remain to be solved in the food processing days that lie ahead. But with all its responsibilities, men have little control over the weather. A severe drought could wipe out all of man's quickly laid plans. If we are tempted to become over-optimistic with the thought that the food situation probably is not so serious as it is painted, it will be well to remember that last year's crop season in 1941 was due to better

than average growing conditions.

The war-time food crisis that now confronts us is not met only by immediate measures to meet a food production simple to allow for adverse weather conditions. The food processing industry is capable, but has not been granted the needed help, in coping with its task. The food problem as a whole involves all phases of production, processing and distribution. And if we are to meet the problems that now beset us, all these of them must be considered under a single administrative control. "Food will save the war and write the peace!" But if American food is to do that double job, we must develop a capacity for food administration comparable with the genius of our food industries.



President, McGraw-Hill Publishing Company, Inc.

## New Appointment Will Strengthen WPB Production Set-up

More or so learn quite early in life that when you are sick, you consult a physician; when you are sued, you seek the advice of an attorney. These truths are held to be self-evident . . . everywhere but in some parts of Washington. And so it is refreshing to learn that broader responsibilities for the aviation production program are now in the hands of a man who knows the business—Theodore Paul Wright.

The program has benefited since the beginning from Ted Wright's broad experience in aviation. In fact, much of the credit for the basic soundness of the production effort can be traced directly to his straight thinking. But it required the keen insight of Charles E. Wilson to recognize that he had this valuable talent in his own organization and to make full use of it in his recent reorganization of the Aircraft Production Board.

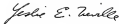
T. P. Wainwright went to Washington as consultant to the old National Defense Advisory Committee in the spring of 1940. After working closely with the Army, Navy, and the industry in laying the foundations for the orderly expansion of the industry, he returned briefly to his former job as vice-president and director of engineering for Curtiss-Wright. Then, early in 1941, he went back to Washington (at a substantial personal sacrifice) to become assistant chief of the aircraft section of the Office of Production Management.

When OPA was transformed into WPB he continued to keep his fingers on the aircraft program, and last December he organized the present Aircraft Resources Control Office (page 110, Feb. AVIATION). His appointment as director of this office and as a member of the policy-forming Aircraft Production Board was formally legitimized on March 6.

Few men know the complexities of the aviation industry and its government relations as well as T. P. Wright. He acquired a knowledge of the procurement side of the picture in his first job as an inspector of naval aircraft in 1920, immediately after being graduated from M.I.T. Turning to manufacturing, he soon became chief engineer of the old Curtiss Aeroplane & Motor Co., where he directed the engineering development of many military and commercial aircraft. His manufacturing experience includes production as well as engineering responsibilities, and he has been a direct and frequent observer of foreign manufacturing methods.

THIS BACKGROUND is tremendously useful for the difficult assignment of balancing the requirements and viewpoints of the Army, Navy, WPB, and aircraft industry. Only a man who knows the problems of both engineering and production and the needs of our armed forces can determine wisely the time when it is most advantageous to feed new designs into the production line, when to shift production emphasis according to current needs, and how to tackle the material and manpower problems that lie ahead.

Mr. Wilson is deserving of high commendation for this new appointment. The Army, the Navy, the aviation industry, and the nation have reason for a deeper feeling of confidence in the military aircraft production program than they have ever had before.





## America at War

**We grow stronger in air—Germany and Japan weaker. Our airman triumph in every war theatre, plane production soars, new formidable fighting craft are heralded, and "Corsairs" see first action. Moonlines, home front bottles lilt of over-optimism to hasten packing of Victory "pipeline" so "100 planes fed in this and will burn 100 from business and against enemy."**

**A**SKED to select the five outstanding developments of recent date relative to America's air war efforts, as two people would come up with precisely the same choices. But the majority of such lists would include most of the following:

Army Air Force day bombing of Europe has become an established success, though Gen. Haler recently found it profitable to allow misunderstanding of it.

Wings of our Central Air Base has brought Brig. Gen. Claire Chennault, commander of the China Air Task Force, to say that the Japanese air force has hit its peak and is now on the down grade. (Chennault months ago said the Luftwaffe was declining.)

War Production Board officials state, though not for specific quotation, that we will hit a plane output rate of 12,000 per month in December, that we will come pretty close to the '43 quota are put at some 101,000, and

that we could build about 150,000 in '44. Questions whether we and our allies can use that many has still to be answered.

United States air power alone, in 1944, will be superior in planes and manpower to that of the entire Axis, according to Maj. Gen. I. H. Edwards, Army assistant chief of staff.

That Germany may collapse sooner than expected has come to the belief of more and more persons who are in a position to judge. And fewer people think she can stand another winter after the next one. The Russian Army meanwhile is harrying the Nazis worse than anything else, and next in weight to this Soviet attack is the Anglo-American air operation.

The Senate Veterans Committee, a special group investigating war production, is conducting a continuous inquiry into operations at aircraft plants. The



**Auto-assembly output of 12,000 airplanes per month is forecast by next December. This picture is roughly 100,000 airplanes in 1944, notes question: "Will victory require such a huge armada?" Seen (left) is Boeing plant opening *Forwarder Consolidated* (below) making *Libertys*, line-crafting ships which are coming increasingly in day bombing over Continent.**



**Notable performance** has been chalked up by Lt. Col. V. Knight (center) who flew 1000+ hours in combat as well as Japan in South Pacific. Knight also notes that *Goodyear* is now producing the point-point *Liberty* engine.

committee was moved to special activity lately by complaints from the Army that some types of useful planes were not being delivered.

United's 2,000-hp. Vought shipboard fighter, the P4U Corsair, has gone into action in the Pacific. At the same time, Goodyear announced it is producing Corsairs in their entirety, and Brewster Aeronautical, too, is building them.

The Army has several new airplane designs, some in the final paper stages and some in the air, which move even the engineers at Wright Field to the use of superlatives. But most informed persons believe that the war will be fought and won for the most part with existing standard types.

The Anti-Submarine Command of the Army Air Force, organized to take over the coastal patrol functions of the First Bomber Command, has extended its operations across the Atlantic. And that is just one step at the iron fist (and the most formidable of all Nazi weapons) which are being slowly but surely beaten by laborious attack and inherent building of vessels. And let us append mention of a sort of old-time occupation—the airplane builders are crystallizing some

plans for converting their overgrown capacities in various other goods after the war, including such items as cars and houses.

One trouble with any such present delirious vocabulary of our part in the war is that it breeds the optimism. And we may well pause and give ear to those hard-headed souls who never supercharge their hopes above immediate attention. They are the men who say: "To predict the toppling of the Axis by such and such a date—when the U-boats still range the seas unchecked, when the enemy still retains a hold in North Africa, and when an Allied breakthrough on the Continent is yet to be forced—is foolhardy."

Surely, we have a big job parrying the troubles of over-optimism. War manufacturers say that every time a series of good war reports come in, the workers take a layoff or start joking around. The whole country lets down. Nobody on our side likes that. We want to keep up full steam in order to knock out the enemy as quickly as possible in order to end the enormous cost.

Everybody now knows that the Allies have the wherewithal to do the job. If you will look at a map of the world (Turn to page 195).



## Edmund T. Allen



unquestioned world supremacy of American air transport which was achieved during the thirties.

American military aviation would have achieved supremacy at the same time if the nation had heeded Eddie's warning. He was the first American aviator to report on the results of German Air Power following a European visit in 1935. His alarming discoveries were then presented in this publication as a series of three articles, Dec., Jan., and Feb., 1936-1938.

Another profound impression resulting from his European trip was a keen appreciation of the technological state of flight test procedure on the continent by the Germans. Up to that time we had been content to rush through this important phase of development quickly and from out the remaining bugs in subsequent operations. Eddie realized that he would find ways to improve our test procedure to the point where it would stand that of the Germans in comparison and he set about the task. It was in this work that he was most deeply engaged, and as a result the Wright Wright Lecture was added to his long list of honors. It is agreed with his contemporary presence, he desired that his best work be reported in AVIATION. And the list of his last three articles appears herewith.

The conquest of time and space and the possession of our present airway affairs will be retarded by the loss of Eddie Allen. The work he has done is a necessary part of progress, and the able men of the organization he has built must carry on. There is a man shortage and a sharp challenge to do the job as he would have had them do it.



The late Eddie Allen, renowned test pilot, head of Boeing's Flight & Aerodynamic Div., and author of the article, making final adjustments on a wind tunnel model of the Boeing Stearman. An engine and its engine, Mr. Allen contributed much to the development of modern aircraft.

## Flight Testing Is a Sound Business

By EDMUND T. ALLEN

Director of Flight and Development, Boeing Aircraft Co.

Edmund T. Allen gave his best efforts—and finally his life—to the advancement of the major science of flight testing. In this first of three significant articles comprising his last written contribution he has outlined the vital purpose of his work and revealed the careful organization of his personnel and the structure of his department.

continuously to perform a design function as a quantitative basis.

Like any other product requiring engineering, an aircraft should fulfill completely and satisfactorily the purpose for which it is intended. On some occasions in the past it has been necessary to establish proof of this fulfillment by long series of experiments, most frequently not on the part of the main structure, but on the part of the engine or operator of the aircraft. Information pertaining to this type of operation seldom, if ever, reaches the manufacturer, and in the few instances when it does arrive the information is so much a piece of it as of little or no use. In the past, a gap has existed between airplane design and operation

A member of the test pilot, according to the usual story told by fiction writers and motion picture producers, is a dapper sort of fellow, not infrequently long on courage and short on brains, who takes up a newly designed ship, whips it through the air a few times, then goes into a vertical dive that ends in a 90 pull-out. If the wings don't fold up, the ship is pronounced

safe and the company goes into production of the new model. What happens to the test pilot during the intervening years while this model is being produced has never been revealed by fiction writers.

Actually, flight testing today is not a spontaneous, haphazard, derivative occupation. For many years it has been a sound, scientific business, operating

Before the present world upheaval there is a greater light for freedom that transcends the military might of nations. It is the eternal struggle of all mankind to better nations. The war of flight is but one example of battle was in this war for transportation. The legend of aviation are placed on the threshold of even greater things involving forces so powerful that the human race dare not risk their possible use for destruction rather than creation. We must win this war in order to keep these forces in responsible hands.

There is vast creative excitement but little glory for the pioneers of thought who labor on the fringe of the unknown. Often there is martyrdom. The technological men who have taken man to the heavens they conquer, the most successful who may come they find themselves within the sphere of some reaction they create, the extraordinary men who must test new design theories under dangerous flight conditions to insure safety for

where are no less known than the military leaders who fall in battle.

The technological men have had their full share of martyrdom. Those of us who have followed the industry through the years have collected a protective shield against the shocks that come to us from time to time. But the nobility of this industry mechanism becomes apparent when we learn of such losses as that of Edmund T. Allen.

Eddie took no farthings from the front lines of achievement. He was possessed of a rare gift for combining theory and practice in the most useful proportions. His work as cruising control in scheduled operations in collaboration with W. Foster O'wold (AVIATION, Feb., 1936-Jan., 1938) gave the first real meaning to air transport schedules and showed the way toward more efficient, reliable, and safer air travel. The development of this technique, which enabled the airlines to follow flight plans across oceanic airways, contributed importantly to the







proper organization again are the only way.

At Boeing there has been established a hard and fast rule: the accurate following of a test flight, the accurate recording in the conference room, accompanied by a stenographer. The flight and all aspects of the tests are discussed by the crew, and tentative conclusions are reached. It is the purpose of these sessions to draw the essence of further service, to indicate the results accomplished and the scope of those results, and to assure that the information is consistent and comprehensible.

The film from the recording camera is taken to the flight test laboratory, where it is processed and the results projected on enlargement paper. The rough draft is corrected and turned over to the clerical group which photographs it during the night. The photographic results are used in an analysis group which breaks down the various facts and prepares graphs and charts on the results of the test flight. The information is rapidly duplicated and added to the manuscript report. By noon of the following day every interested person in the Boeing plant has a complete preliminary report on the flight test.

Every attempt is made by the flight test to avoid a final solution of data which has not been evaluated for accuracy or sufficiency in arriving at results. The value of the results is decided upon through proper collaboration with the design team. The group must be thoroughly conversant with the details of the tests proposed and being conducted, in order to assist the tests intelligently and contribute to the detailed technical studies.

As the flight test group is the only link to the company which makes into direct contact with the problems that confront the operators of aircraft produced, it cannot be casual or haphazard in its approach to these problems, nor

should it be hampered in presenting the truths resulting from the actual flight test. The derivation of a flight test group in this policy will in later years be reflected in the volume of future business which the manufacturer enjoys.

Because a flight test unit, in the performance of its duties, is operating in cooperation with a large number of engineering groups is an organization, this single group must determine the test procedure. Especially in these days of war, the importance of this phase cannot be over emphasized. In some instances the purpose of a test may be to obtain information of academic interest only, and, in such, is interpreted into the overall program by the Boeing flight test unit on the basis of importance for use in the final military service, which at present is the Boeing Flying Fortress.

In determining the priorities for test items, the Boeing company took cognizance of the fact that the tests were to be made on large four engine aircraft, a manufacturing field in which Boeing preempts. A major portion of the flight testing in the strategical beyond the boundaries of general human knowledge. Handling an aircraft and over into the region during the early days of Boeing's high altitude research was never considered as the normal occupation in the world. But every known safety precaution was taken.

Although the early benefits in this type of testing are now abundantly realized, the cost of high altitude flying has not been overcome. Sending a large four-engine aircraft such as the Flying Fortress to 30,000 ft. or better represents a cost of about \$1,000 per hour. For some business purposes it was necessary to devise a method of making each test flight as productive as possible. Single flights have accomplished more than a score of others, and in some instances the time to be tested

is checked for a dozen or more consecutive flights, depending upon the nature of the item.

When an engineering group at Boeing develops any item which will require a flight testing, a preliminary outline of the item and the test desired is submitted to the flight test unit. Then the flight test unit evaluates the item against the other tests that must be made.

From the preliminary outline, the flight test engineers work out the details of the test, planning and stipulating the material necessary, and scheduling any special equipment installations which must be made on test airplanes for the isolation of the particular test items involved.

In the event that the preliminary test item is of such nature that the information contained in the preliminary outline is insufficient for the flight test unit to make plans, a second and more extensive outline, including blueprints, is submitted. After the test item has been scheduled and the planning completed, the director of flight and arrangements, the chief of flight test, the flight test operations engineer, the flight test equipment engineer, and the flight test analysis engineer meet to discuss the test. Included in these conferences are also other parties concerned.

The discussion centers around the test in general, the portion of the aircraft involved, and the results desired. For each, an explanation of the measure in which it is related to the entire problem and a statement of summary of data required, is given. The flight test equipment group will then decide or design the instruments needed, with the range and accuracy required, and in the case of a new instrument, a description of it will be prepared. Prior to the actual test flight, the test crew, usually composed of ten men, meets with the flight test operations engineer and the chief of flight test, and the entire test program for the flight is reviewed, with each item explained, so that every member of the crew will thoroughly understand his part.

Pre-flight conferences last from 30 min. to 1 hr. and as a measure to insure that each member of the crew will fully understand his part in the test, the head of the engineering staff is involved in the comprehensive flight test, and the representatives of accessory manufacturers, if they are involved, stand by to answer any specific question or provide additional information. The crew, with man armed with a flight test plan, a manuscript form which includes every item in the test, and his particular function for each item, leaves the conference. Then, each member has a thorough understanding of his duties for the test in question.

## "She takes me there and she Brings me Back!"

"MAYBE GUYPAIN ANNIE'S out as pretty as she used to be. Boy AA has faded her face a few times, and has shiny hair that shined girl complexion. But she takes me where I'm heading fast, and then she brings me home. And the drive on her is another good one because she's a real car when her five brown out and going home."



"AFTER THE WAR, my wife will probably have her up when we sleep for a family plane. She can have her choice of color, but I'll choose the instrument—precision instruments that can take it when the going gets tough, and still tell the truth. When I fly, I want to know where I'm going. With me, it's not just fast—it's time now."



TYPICAL of today's top precision instruments is the Kollsman Direction Indicator. Its easy to read dial corresponds to the compass rose appearing on all navigation charts. The reference index pointer can be set to any desired heading by moving the knob in the bottom of the dial. . . . and a steady course can easily be held by keeping the pointer marked.



Boeing's Flying Fortress is a test plane—first, last and always. Even when he was flying the test—state of the art in Boeing's tests in that stream line—he was known as "the flying fortress" because of his knowledge to add to his and the world's knowledge of aircraft and flying.



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# ABSENTEEISM...

## What's the Problem?

A realistic appraisal of the aircraft industry's position analyzing causes and effects and showing how aviation has taken a nation-wide lead in bettering an already-poor record.

Agreement among war industries has brought a mass of changes as to responsibility—a bewildering array of statistics and a multitude of "wars" ranging from work-a-light programs to advocacy of prohibition in war plant zones.

What generally every "Man," whether states or mere headline seeking, has forgotten in this confusion—which has borne much of the brunt of absentee publicity—is the only industry which has yet made a concerted effort to whip the problem without resort to "moralistic implications."

Working through the two Aircraft War Production Councils, the young

plane building industry is the first to attack the problem as it had to be attacked—by finding out the causes of the absenteeism. It is the first industry to offer government agencies tangible means of offering the cure of the source. This offer has been made through a special subcommittee which is already at work with government officials regarding the subject.

Absenteeism in the aircraft industry presents neither a mystery nor a gloomy picture. The right transfer assignment of the Aircraft War Production Council, Inc., on the West Coast had reached average absenteeism per employee to 6.2 percent by the end of January,

and the east was still going down from a figure of more than 7 percent late last year. Members of the East Coast Council had absentee averages ranging from 5 to 8.5 percent late in February, the overall rate probably being just about equal to the Pacific group.

Just what these figures mean in terms of time and aircraft production certainly lost count to assembly material, despite many widely quoted statistics. For one of the most serious statistics the aircraft producers have to handle in the fight against absenteeism is the truth of the materials shortage, the truth is every employee knows it. Had every employer been on hand every day during these extended periods last year, it is probable that the production rate would have shown little, if any, increase. Materials were the dominant limiting factor.

Some worry of the material shortage has been eliminated, absenteeism is at a point where it will count more

and more heavily in the production output rate. The very knowledge of that fact alone by every employer may help account for part of the steady decline of absenteeism.

A study of major causes of absenteeism gives a clue to some of the methods used to combat them by aircraft manufacturers, first as individuals and then through their Production Councils. The Interdepartmental Subcommittee on Absenteeism set up by the federal government lists three general classifications of causes, only some of which apply to all plants, but all of which contribute directly or indirectly. They are given below.

First—in-plant problems, subdivided as follows:

1. **Design.** This involves long hours, long waiting for material, complex details, lack of employee knowledge. As the average age of warplane craftsmen and the percentage of women employees rises, management tries new production methods for, example, the possibility of re-arranging all assembly work and its consequent changes at loading.

2. **Job morale.** This can be affected by material shortages, labor practices and a dozen other factors. Since it is one of those intangibles, education—or, as one labor leader put it, "bellyache"—is necessary.

3. **Inadequate personnel policy on absenteeism,** such as lack of plant records as to causes, inadequate medical programs, or lack of labor participation.

4. **In-plant accidents.**

The second major classification embraces individual employee problems, subdivided these:

1. **Illness,** which has been shown to be greater among older workers and women, who together now account for a majority of aircraft workers.

2. **Accidents outside the plant.**

3. **Home responsibilities of women workers.**

4. **General lack of morale.** Separate from job morale and trend of lack of enthusiasm for winning the war, personal problems, experience of being drafted, etc.

5. **Job shopping.** Looking for a better berth or higher pay.

6. **Lack of need for the pay check.**

7. **Leisure.** Reading, taking long weekends, spending in the sea to go fishing or hunting.

The third major cause of absenteeism releases community conditions, such as:

1. **Inadequate housing.**

2. **Unadequate transportation.**

3. **Rebuilding and draft board problems.**

(Turn to page 313)



Shocks of weakness due to absenteeism cost all too heavily as "Monday morning hang-over," for there are many other business-critical materials shortages, which are often beyond the control of either management or employees. Working through their two Aircraft War Production Councils, airplane builders are shaping absenteeism by finding its causes.

Many headlines have appeared warning "watching" absentee figures on the aircraft industry, but few of the statistics quoted have reached their figures to show the reason. Here, presented for the first time, is a breakdown of absenteeism for a large aircraft producer showing the reasons why.

It shows a good many reasons—either the workers' or management's fault—why workers didn't get to the production line and show their "dedication."

Reasons for Absence	Number of Employees Reporting		Percentage of Total Reports	
	Men	Women	Men	Women
Illness of employee	269	345	14.3	30.3
Illness or death in the family	20	61	9.9	12.4
Transportation difficulties—				
Car trouble	36	31	7.1	6.8
Driver	2	9	2.1	1.7
Tire trouble	2	5	1.5	1.1
Other	7	7	2.9	1.4
Auto accidents	2	8	1.5	1.6
Military training	5	0	1.4	0
Employees serving now in children's institutions	6	3	2.9	1.6
Maternity leave	11	24	2.2	6.8
<b>TOTAL REPORTS</b>	<b>362</b>	<b>691</b>	<b>100%</b>	<b>100%</b>



Employee transportation today constitutes one of the most frequent causes of absenteeism—often being the second highest cause. From all indications, it will continue a tough nut to crack.



Getting the little men who aren't there—the absentee workers—into the picture is not the problem when pictured by headline hunters, for aircraft manufacturers have already initiated the last industry-wide program to solve it. Aviation's absentee record, better

than that of many other industries, has shown constant improvement, and the industry's own all-time low will become the example which others throughout the country will follow. Aviation is fast to make industry-wide attack on problems.



# Trail Blazing in the Skies

1920



## THE FIRST BULLET-PUNCTURE-SEALING GASOLINE TANK

for military airplanes was developed by Goodyear at the close of World War I. After exhaustive tests it was adopted by the Army Air Corps and Goodyear was officially commended in 1920 for its invention. That is a matter of record, as was its effectiveness in sealing punctures made by the small-caliber armament then carried by planes.

### NOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AVIATION INDUSTRY

1. By building parts to manufacturers' specifications.
2. By designing parts for all types of planes.
3. By re-engineering parts for mass production.
4. By extending our research facilities to solve the solution of any design or construction problem.

1943



## AS A RESULT OF THIS EXPERIENCE,

Goodyear is today building bullet-puncture-sealing tanks that self-close punctures made by modern heavy-caliber ammunition which rips jagged, flaring holes in ordinary metal tanks. So swift is this sealing action, very little gas is lost and the danger of fire from incendiary bullets is greatly reduced. Goodyear supplies all types and sizes of these tanks to fit the varying needs of both fighter and bomber planes.





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Where alignment is a factor in control mechanisms Timken Bearings have another point in their favor for they hold shafts, wheels, pulleys in constant alignment. Moreover, the design of the Timken Bearing permits the achievement of any desired degree of tension whenever they are used.

Look over your present designs of heavy duty control to see where Timken Bearings can be used to advantage. Keep the advantages of Timken Bearings in mind along with those designs you have in the back of your head but not yet on paper which will be incorporated in planes of the future. A wide range of sizes are available for your selection.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

"All There Is In Bearings!"

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## Consolidated Celebrates Its

# 20th Anniversary



In the 20 years of this company's development it has gained experience with nearly every type of airplane. Here is the history of its growth and of the aircraft produced from 1923 to the present time.

Organized 20 years ago this month by Maj. Andrew H. Fleet in Genesee, N. Y., Consolidated Aircraft moved, the following year, to Buffalo, where training planes were built. This was the plant site after four years.

TWENTY YEARS EARLY in the 20th anniversary of Consolidated Aircraft Corp. Known all over the world today as one of the leading makers of large airplanes, this company was formed in 1923 by Maj. Andrew H. Fleet in Genesee, N. Y.

At that time, it shared quarters with the Galehead Aircraft Corp., and its first order was for 50 training planes. Now joined with Vultee, it becomes one of the largest aircraft companies in the world.

In 1924, an important development took place which contributed much to Consolidated's present position. Vultee Aircraft acquired 34 percent of Consolidated's outstanding common stock, which brought in a company already highly regarded for its products the managerial experience that pleased



It would be hard to say one of Consolidated's plants today, but in 1923 this was the company's complete machine shop, including sheet metal operations shown in background. Primary trainers were the product.

The PT-3, produced in considerable numbers at the Buffalo plant from 1924 to 1929. Powered by Wright J-5's, they were strong reliable craft.



In 1926 Consolidated began work on large flying boats under direction of I. M. Laddin, new executive vice-president and general manager. First developed was the Admiral for the Navy, a modification being the Commodore (shown above) a 31 passenger craft used by NYPEA over what was then the world's largest oilfield, totaling 55,000 ac. from U. S. to Russian Asia, touching 15 countries.



With this Fleet two-place biplane, Gen obtained control of the commercial production field in 1925, selling some 600.

successful methods in producing steel at Republic and smaller aircraft at Vultee.

Since Vultee previously had made small planes for private use, and now makes basic trainers, observation planes, fighters, and dive bombers, while Consolidated has long specialized in heavy bombers and large ships, the two firms complemented each other in product and experience.

### Company Development

Consolidated's first order was for 38 two-place craft by order training planes of Dayton-Wright design for the Army Air Corps. Following this the company produced training ships of its own design, which brought about a need for larger quarters. In 1924 it moved to Buffalo, N. Y., where it occupied the old wartime plant of Curtiss.

From 1924 to 1929 it produced hundreds of primary trainers, the PT-3's for both Army and Navy. These were simple, rugged craft, powered by Wright J-5's engines, which did adaptable service with new standards of safety, in turning out flyers.

In 1930 the company made its first entry into the commercial field on a synthetic basis, with the sale and delivery of about 600 Fleet two-seater biplanes, which measured 25 ft. in span and were powered by 40- to 50-hp engines.

Even more important to the company's future was the beginning, in 1926, of specialization on flying boats of advanced design, under direction of designer I. M. Laddin. This policy has made the company known as a leader in this field.

One of these flying boats was the Admiral, built for the Navy in 1926. It had a span of 180 ft., and was the first



Production line, 1932 model, for building PT-3's as an order of 24 for the Navy. Note also prominent "cradles" for hulls, a construction method still extensively used eleven years later.



Port of the Commodore, the 1935. In 1934 the Navy flew six of these in formation, ascending, from San Francisco to Honolulu. Twenty three were sold to the Navy.



Two-place Army attack plane, one of 50 delivered in 1933 on the first order from the San Diego plant. Note the turbo-supercharger mounted outside.





Plans for the prototype of the PBY Catalina were drawn up in 1936. It is now the largest plane in production at Consolidated, and exhibits the knowledge of long experience in this field.



One of the outstanding achievements of Consolidated's development of large planes is the B-24 Liberator. Research on this design was started in 1936. It holds the Atlantic crossing record of 8 hr. 43 min.

large monoplane flying boat produced in America up to this time. A modification of this design was the Catalina, which had a maximum capacity of 33 passengers. By 1939 these ships were being operated in South American service over what was then the world's longest airline, extending 9,860 mi. through 15 countries. This route was later abandoned by Pan American to become the latter company's South American out-and-back run.

Following the Catalina came the PBY design, 306 ft. in span and 62 ft. long, of which 25 were sold to the Navy in January of 1934. The Navy showed

the value of this type by fixing six PBYs in formation from San Francisco to Honolulu—the first 2,400-mi. non-stop formation-flying flight—which opened a new field to Naval operations. Twenty-three more ships, of the present PBY 2 and 3 type, were also delivered to the Navy.

As a natural consequence of flying boat development and the attendant need for an air base within the year round, Consolidated moved from Buffalo to San Diego, Calif. in 1935, where constant research and experiment was possible.

The first order completed here was a

lot of 58 two-place attack planes for the Army, which was of considerable interest now because of the early application of a turbo-propeller. A three blade propeller was also used as a single-engine ship.

It was in San Diego that the Navy placed first orders for PBY two-engine flying boats, which have now built up an unbroken history in this war as the Catalina patrol leaders. After delivery of the first PBY, this type piled up many records, including non-stop group flights from San Diego to Panama and Hawaii, San Rafael Yafusa's 18,000 mi. trip in the Arctic search for the lost Henson Stern, and Richard Aschbacher's flight in the first equatorial globe circling flight by a single plane. The pilot on the last trip was Russell Rogers, who is now Consolidated's flight and service manager, commanding the pilots who fly Consolidated ships in many regions under the United States flag.

In 1936 came the design of the four-engine XPBY-1 flying boat, which was the forerunner of the present PBY Catalina. This is now the largest Consolidated plane in production, as well as the largest and most powerful in service with the Navy.

Research began in 1935 on the design of a large land-based bomber situated the situation of the Army in 1935, resulting in the new famous B-24 Liberator, which, among many other achievements, holds a 6 hr. 40 min. record for crossing the Atlantic. As the C-87, with a reinforced fuselage and without landing, the same plane carries six ton loads more than 3,400 mi., and holds the Pacific to Europe record, taking those from Australia to San Francisco in under 35 hr.

With the addition of the Valiant line



The C-47, converted to transport service from the B-24, is one of the largest land carriers. This version is

derived off the same line, in color, as the B-24. It has flown from Australia to San Francisco in less than 36 hr.



The Valiant-Sikorski Seafish, now used by the Army for observation and liaison. With the addition of Valiant Aircraft, Consolidated covers a wide range from the B to the PBY.



Familiar to civilian users is the Valiant-Sikorski Seafish, which has been assigned to British overseas shipping. This adds another type to Consolidated's varied production.

of planes, the Consolidated family becomes a large one, meeting nearly every type. The original Consolidated group now consists of four types, comprising

some of the largest and most important aircraft in aviation.

First in the old reliable Catalina, one of the oldest in active operation. Is the

for long bloody battles of the Pacific, those who know credit this ship with a winning part only for persevering. (Turn to page 968)



Nearly 5000 'real' Valiant B-24s. The ship is now one of the largest Consolidated lines. Quite a new line of the PBY, these planes were Army's largest order ever placed in one type of plane.

\*Consolidated Aircraft Corp. now plans to B-24 and merge with Valiant to form the Consolidated Valiant Aircraft Corp.—a milestone in aviation history.

Following this article on the growth of Consolidated is a description of the company's most spectacular war production effort—turning out the mighty B-24 Liberator bombers and the all-weather cargo carrier, the C-47 Liberator Express from the same assembly line in Texas.

The last phase in production is manufacturing of assembly line aircraft to accommodate the most up-to-date design changes. Consolidated's important manufacturing center at Arizona is described on page 126.

To round out the picture of a major aircraft producer in operation, there is an article on how Consolidated has established a distinctive subcontracting system to secure a steady flow of parts for the assembly line (page 205).



A capable dive bomber, the Valiant Vengeance is also used by the British. It can be held to a low diving speed and is used to be assembly study. It completes the Consolidated group.



# Single Assembly Line Produces Both Bombers and Transports

By E. G. SEBOLD, Chief Engineer, and  
S. J. POWELL, Factory Manager, Ford Works, Detroit



One will be a Liberator bomber, the other a Liberator Express cargo plane. Above, Consolidated workers attach side panels, bomb racks, and set walls to wing center section, key substantially B-24 shaped divisions but to safeguard, holding side panels in place and leaving out wall ones at least one of last. Right, side panels at cargo section are attached to bomb bay making up the new element of bomb racks and out walls but several are all T-shaped divisions but (left, ground) to hold side panels right while windows are cut.



Close-up of screw jacks supporting wing center section as fuselage mating begins for producing both bombers and cargo planes. Mass arrangement of electric cables on sides of jacks.



One of two pairs of screw jacks which support wing center section while nose and tail fuselage sections are added to fuselage mating fixtures.

Design and production coordination at Consolidated's Texas plant turns out both B-24 "Liberator" bombers or C-87 "Liberator Express" cargo-transporters without cutting production rate. Most changes are made on floor assembly line.



Airway systems for Consolidated Aircraft Corp.'s Texas plant when the Army Air Forces sent through a rush order for conversion of B-24 Liberator bombers into transports.

The Liberator had already won a name for itself as an adaptable transport in the latter days of the conversion of Japs, when it soon became known that well-passioned and important requests could be secured as the money fuselage and with additional cargo pushed in the nose where bombs once had gone. Other bombers available couldn't be adapted as easily-needed cargo sections to more big trade game divisions as easily as could the B-24, so while the former retired hands on advancing Japs, the Liberators shifted readily among in the background. But they brought out the newly needed equipment and invaluable men that are fighting again.

The immediate necessity for carrying cargo up out of reach of submarine-ship-sinking torpedoes brought Consolidated a hurry-up order to easily make transports out of the bomber-transports that can carry over six tons more than 3,000 mi. at speeds in excess of 300 mph, a combination first unmatched by any airplane now in mass production. One of the first C-87s—the Army designation for the cargo version—off the longest mechanical straight production line in the aircraft industry carried Wendell Wilkie and a party of high officials as they globe-walked around and became the first American plane to fly over the treacherous expanses of the Gobi Desert as well as the first to fly from China to the United States via Alaska during wartime. Another brought decorations to Lt. Gen. H. H. Arnold and to the crew by setting a 45-hour flying

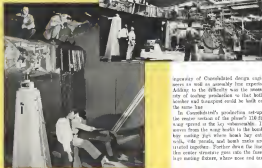
time record from Brooklyn, Kentucky, to Washington, D. C. including stop-overs, the entire trip took only 77 hr, 5 min.

From the outside there is little difference between the B-24 and the transport. The bomb bay has been removed and replaced with a fully covering, the bomb-bay's compartment in the nose has been closed in, with a door installed to permit loading of cargo in the open. The tail gun turret has been unencumbered by adding a door through which long airplane parts, such as wing tips, antennas, and struts, can be put endwise into the ship, and a 6 ft. square cargo door was cut into the tail fuselage.

But, while the lines were little changed, the conversion involved a tremendous amount of engineering, adding on the



**How fuselage sections** is lowered by crane hoist over side dolly on which it will be rolled back for attaching to wing center section and side panels. In this bomber version, bomb bay tracks with extended splice plates will serve as one of tracks between sections. Below, close up of wing section being lowered onto dolly. Bomb bay tracks, which acts as track, can be seen just forward worker's arm. In cargo version, T-shaped structure that would still be in place as track and lowering guide between sections.



ingenuity of Consolidated design engineers is well as assembly line experts. Adding to the difficulty was the necessity of meeting production so that both bomber and transport could be built on the same line.

In Consolidated's production set-up, the center section of the plane's 218 ft wing spread is the key subassembly. It serves from the wing back to the bomb bay making jigs where bomb bay cut-outs, side panels, and bomb tracks are mated together. Further down the line, the center structure goes into the fuselage making fixture, where nose and tail



**With nose and tail fuselage sections** used to erect center wing section in place, center of tail fin support and a wheeled cradle is rolled out to give clearance for installation of

fixed belly section. Then, employees move belly, which has been built as separate subassembly, into place to connect bomb bay opening, one step in connecting B-24 and C-47.



**Left, after nose and tail fuselage sections** have been mated to wing center section, ship is lifted from mating fixture by overhead monorail cranes to be moved to final assembly line. Below, bomber brought down making fixture is lowered into final assembly line inside at Texas plant. The bars between such cranes mount center line along with planes at 45 deg. angle to direction of travel. Next place might be cargo version, but speed of level of line would remain the same.

fuselage sections are added. From the mating fixture the plane is lifted to the final assembly line and moves, pulled through station after station while workers add inside modifications, enter wing panels, motor, propellers—everything needed to make of a finished ship.

Again were the design problems involved in achieving this flexibility, a work met requirements for both bomber and transport and brought two production records to the Texas plant.

One was substitution of the refueled belly section for bomb bay doors, bomb tracks, and cut walls. Although B-24 were made to fit the belly into the bomb bay mating fixture and mated it to the side panels assembled there to the wing center section. But the arrangement proved unsatisfactory, so the wing was removed by the bomb bay fixture and jacks, up side panels and a "stretch" bar, the arms of which reach between the sub-panels to hold them rigidly in place while window openings are set.

When the assembly reaches the fuselage making fixture, jacks push support the wing center section and the nose and tail fuselage sections are brought by overhead crane to a mated cradle which moves them into the mating fixture. There a section line jigs, stretching from nose to tail fuselage sections, is slipped in as a series of shims and is substituted for the cut-tracks which serve a similar purpose in the making of the bomber components.

Nose and tail are then joined to the wing center section and the lowering jigs and stretch bar is removed. A wooden stand is put beneath the aft end of the tail for support and the wheeled cradle is rolled backward out of the way to give clearance for movement of the belly.

Back on opposite jigs and a rest in itself, this section covers the gaping nose of the Liberator's long bomb bay and



**Below, while outward appearance of B-24 bomber and C-47 cargo transport is much the same, necessary design changes run into hundreds.** Bulkheads inside which these Consolidated sections stand are at same station in both versions. Note in transport version (left) how bulkhead has been strengthened in bomber, right, portion of the bulkhead cradles a grooved overhead support beam legs. Same opening in center wall, as finished plane, give access to cut with between bomb tracks.







when it reaches the mating jig, lacks only trimming of skin and strapping of being a completely finished unit. Once stripped in place, overtyping skin and bulk frame are cut to proper alignment and secured in position. Sphere plates are riveted and bolted and the ship is ready for lifting out of the mating frame.

Reinforced changes in the C-82 necessary to carry heavy cargo loads are made placed entirely in the tail finelage section. Bulkheads are "bolted up" and ball frames and flooring supports added. But the major conversion changes involve putting in the 6-11 square cargo door—big enough to permit loading of

floor structural differences in finelages of Liberator bomber and transport are shown here. In cargo version (left), sections are called "chassis" brackets along strengthened floor beams. Note differences in floor beams and "bolted up" bulkheads compared with bomber (right). Changes were made to handle different load distributions.

Below: addition of extra bulkhead is necessary in cargo transport to give strength for fish, cargo opening. Left, women worker trims 33-sheet made on new bulkhead. Just above and to right of her hands is ball frame (part of it cut away in making cargo door opening), which is same place in the ship as ball frame being drilled in bomber version by men (right).

complete engines and huge parking units.

From one of the bulkheads which is reinforced to take most of the load of the aft and belly tank, is a bulkhead on the passenger side of the cargo door, strengthening sections are added. A bulkhead is inserted in place of strengtheners at the top and bottom of the door and a heavy reinforcing skin riveted all around the opening and extended underneath the finelage.

Ribs, stringers, and flooring strips complete the opening and ready it for the door, which is added along the full x-rail line.

While the plane is still in the finelage

making job, the remaining windows are beamed and cut. Three of the seven on each side are included in the side panel which is attached to the wing main section in the lower bay mating fixture and have been cut before the assembly reaches the finelage beam operation. The other four are cut a step or so previous to addition of the belly.

A steel template is fitted to the finelage at the bottom edge of the side panel and the remaining windows worked. All seven are about 12 in. high and 18 in. wide and are beamed about 2 ft apart. They reach from just behind the wing along the length of the ship toward the cargo door.

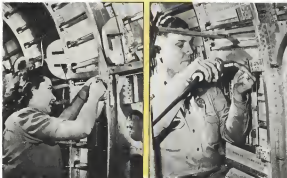
When the working has been completed, the template is removed and cutting-out of the window begins. First, skin rivets are drilled out, then the opening cut with carbide routers. Later firing stringer portions are milled away and reinforcing loadens put in. A window sill is added on the inboard side and beveled-edge window patches riveted on the outboard side. Final assembly section complete the firing with Plexiglas windows.

In reworking the bomber, each change brought others. Putting in windows, for example, necessitates complete reworking of the surface around sections as well as changes in the instrumentation lines and electrical wiring.

Most of these cables are beamed and run beneath the window level. Putting them there brought them into the cargo area, so unimpeded they could pass-



Installation of 6-11, cargo door in process. Loading of complete engines necessitated some major design changes. Strengthening sections are added to finelages from struts placed in cargo-passenger side. Longitudinal is inserted in place of stringers at top and bottom of door and heavier reinforcing skin is riveted around opening and extended underneath finelage. Installation of door shell takes place at later stage as final assembly line.



Above, strengthening skin patches are riveted around window openings in finelage of Liberator Express transport.

Left, reworking of control cables and wiring required in cargo version necessitates addition of aluminum (right) ball frames (in top) and compressed fiber wood padding (below window). Note sound-proofing, heavy padding in lower left hand corner.





**Installation of sound-proofing and exterior trim of transport version, left a big interior headache both in isolation and removal of covering insulation for access to equipment.**



**Cleavage of cargo tie-down brackets attached to strengthened fuselage between bulk frames, one of hundreds of design and production changes required to handle cargo conversion. Most of them are made to final assembly line.**

ing has been added as a protective covering. These panel sections are soaked in hot water tanks in the washing department, formed, and dried. Then they are attached with rivets and bolts to the interior edge of fuselage bulkheads.

Since the proofing extends only to the window levels, in places where the rubber have to be sealed higher—above the cargo door opening, for instance—special steel guard plates and covering must be installed.

Another change was required by the cargo tie-down brackets to provide lashing points, and these, in turn, called for readjusting of bulkheads at those stations. Still another problem was provision of heat for the transport version.



**Design and production changes necessary to suit bombers and cargo transports from same assembly line run from nose to tail. These detail photos show how tail gunner's turret is re-arranged and gun door modified through which long aircraft parts, such**



**as flaps, or struts, can be loaded. On cargo version, bombardier's compartment is replaced by 18-in. baggage container and expanded cargo door, with bulkheads and floor supports strengthened and proofing and strutting line installed.**

straps and jiffy-removable seats so that the plane could carry cargo as well as men. Ducts from the heater are run along the sides of the C-57 at floor level—and that made it necessary to shorten the seat legs on the outboard sides.

Then the rearrange for the hydraulic system which operates wing flaps and landing gear had to be shifted from the bomb bay area, where it had been in the Liberator bomber, to the flight deck area pertinent in order that it would not clutter up valuable cargo space.

Other changes moved the navigator and his table from what had been the bombardier's compartment up to the flight deck. This caused a shifting of the radio operator's position. And the extruder, which had been where the navigator in the nose, was moved back. Relocation of oxygen tank units and installation of bins to collect by each seat are other innovations in the transport, as in the bomber and Republic model proofing and finishing firm which has the interior of the fuselage. The firm is

(Turn to page 440)



**Final cleanup of Liberator Express by Consolidated's Tool and Flight Department, St. Louis—with specially designed cut-head bins to accommodate best design—can easily convert with jiffy action fuselage as fast as this cargo as well as passenger can be moved.**

## Finished Product

**Consolidated C-57 Liberator Express gets engine run preparation to test flight. Design and production ingenuity mean that steps can speed and behind on assembly line could have been either bombers or cargo transports without cutting production rate.**







**Open Splice** Arrived at the modification center field, planes are prepared for entry in the line by having fuel, oil, and oil pumped from their tanks, removable equipment stored, and a leveling device attached to nose wheel axle. Door is disengaged to open to about a plane.

## Modification Centers ... An American Military Innovation

By GLENN HOTCHKISS

*Works Manager, Consolidated Aircraft Modification Center.*

Modification centers relieve back pressure built up on quantity production lines in form of engineering change orders made in light of combat experience. Consolidated center described here is typical of dozens of quickly built plants where "airplane tilters" are making parts and equipment with make-shift tools, to give our airmen "Tomorrow's Fighting Planes Today".



USERS KNOWS aircraft manufactured in the United States will not fail, to do those of the German Luftwaffe on the Russian front in the winter of 1941-42, because of the cold weather. Neither with the need and lack of the snow, nor the sticky mud and humidity of the tropical jungle put them out of action. Because every military plane, for whatever front, is not from a factory, but from a modification center, where it has been specially equipped to meet the conditions under which it will operate.

As far as we know, the United States is the only nation in the war using the modification center plan. Dozens of them are other aircraft in production or rapidly nearing completion in the United States and foreign countries. And it is their combined production, in the final analysis, that is the military aircraft production of the United States. Undoubtedly much of the credit for the modified life and performance records made by U. S. aircraft is due

to first stations, covering and equipment is removed, engine "polished", and tanks covered in preparation for modification.



**Removed covering, parts, and equipment** are stored in racks attached on top of outer wings. Tanks are made at ground, with two partitions creating three compartments. Fuel hose angle brackets which match existing screen in surface of wing and are fastened along by them. Lower propeller blades are covered with canvas flaps.

**Due to nature of work, modified working conditions** ground and will continue to be a continuing factor in modernizing modification centers. Here, a crew of four works around an engine nacelle.

tributable to the fact that each ship is well-stocked and otherwise equipped for specific centers of operations in special missions. What is done is, of course, a military secret. How it is done will be told, in part at least, in this article.

Chronologically, orders for modifica-

tions are received from the several fronts by the Special Projects Branch, Production Division, of the Material Center, AAF, Wright Field. There they are studied and, if practicable, forwarded to the modification center handling the model or type of plane involved.

As orders may include many changes, some of them of such nature they will always have to be made in the modification center, and others that will be made there only temporarily. We estimate that about 25 percent will always be what we now call "permanent" work,



**Leveling device** is so designed that pull is down from cable to roller, rather than through roller of axle wheels. When pressure is released, axle is pulled to add will drop to vertical position, allowing cable to rest on floor, out of way. Steering bar remains in place, but free end rests on floor between wheels.



**Preparatory to moving line of planes, workmen lift removable fuel nose wheel due to work stand. Nose drop brought to match exactly. Work stands are 30x18 ft. and are secured to floor. They have lower shelf for storage of tools and parts. Total is 75x30 ft.**





Line has moved about 12 ft. and part landing wheel is shown to emerge from slot in work stand. When line belts and work stop in its position, the part and work stand slide out to the die.

This 40-ton hydraulic press is forming a bracket with a hand-held remote die. Operator checks the progress by comparing part in press to accepted one. Brain was protected from automatic supply controls and was used to operate his pre-setting press on and off stands.

such as weatherization installations, and 75 percent will be of a "temporary" nature, so handled only until the parent plant can put them into production.

For the latter, the Modification Control engineering department makes drawings that will put the change into production and also sends reports to the parent plant. There, if necessary, they are reviewed and steps are taken to incorporate the changes in the production line. The order will continue to follow and until the change until they come through permanently from the parent plant. By that time, however, orders for still other changes will very likely have arrived and will be in progress. It is expected that this routine will continue throughout the war. And, of course, installation of weatherization and special mission equipment will always have to be done in the modification areas.

When the engineering department has finished its sketches, to be followed later by drawings, the tooling and methods departments go into action. (See page 329.)



Scrapage is a manufacturing problem common also to modification centers. Here, a crew picks certain sizes of rivets from a disassembling conveyor belt. Used rivets are dropped into hoppers on left and those not picked and left into a bin at end of conveyor, to be returned to hoppers and put through again and again until all sizes have been sorted. The operation is about the second step growth of "mass production" marked in modification centers.

## The B.F. Goodrich Airplane of the month **CESSNA BOBCAT**

**WINGED UNIVERSITY.** Many of the skilled pilots who will bomb the Axis tonight received their first Twin Engine instructions in Cessna Bobcat AT-17 Bomber Pilot Trainers. This sturdy ship, used by both the United States Army Air Forces and the Royal Canadian Air Forces, has earned an enviable reputation for excellent flight characteristics combined with high serviceability. The many B. F. Good-

rich products, including famed Silver Crown Tires used by Cessna, have contributed to this fine record. This month

B. F. Goodrich salutes the Cessna Bobcat, a great plane with a fine record on training fields throughout North America.





**B.F. GOODRICH RUBBER RESEARCH FOR THE**

*Aviation industry*



### Smooth Contour Tires for today's faster-landing military aircraft

**T**ODAY'S WARPLANES are landing at greatly increased speeds. They're landing on military airfields . . . often short, often rough, often muddy . . . and they're coming in safely. That's because improvements in landing equipment have kept pace with increased need for safer ground control.

B. F. Goodrich has played an important part in improving warplane ground control by the development of Smooth Contour Silvertown Tires. In addition to giving the same excellent performance and endurance for which B. F. Goodrich Low Pressure Silvertowns are famous, these new tires meet two other basic needs of fast-landing warplanes:

**MAXIMUM BRAKING.** When warplanes come in fast on short, rough fields, they have to be able to stop quickly. And they do stop quickly when B. F. Goodrich Smooth Contour Silvertowns are used on wheels equipped with Expander Tube Brakes.

These brakes expand radially against the centre

inner surface of the brake drums. The B. F. Goodrich Smooth Contour Silvertowns are specially designed with a large head diameter which permits the use of larger wheel discs and consequently larger brake drums. This, in turn, increases the braking surface and the grip of Expander Tube Brakes so that they can stop fast-landing warplanes quickly.

**MAXIMUM GROUND CONTACT.** Warplanes must be able to maneuver fast on the ground, too, without the danger of skidding. B. F. Goodrich Smooth Contour Silvertowns have a wide footprint and non-skid tread which meet the need for maximum ground contact and stability.

Right now, the B. F. Goodrich Smooth Contour Silvertown is proving its worth on world battlefields. It is filling the need for safer ground control at high speeds. And it's just one more reason why landing aircraft manufacturers specify with confidence, "B. F. Goodrich Aviation Equipment."

**MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES**



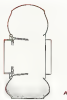
**Why Smooth Contour Silvertowns mean**

**SAFER LANDINGS AT HIGH SPEED!**



#### The advantages of Low Pressure and Smooth Contour Silvertowns are shown in these sketches:

The Low Pressure Silvertown (A), with smaller head diameter, has adequate braking surface for transport and slower-speed ships, plus extra cushioning vital in many operations. The Smooth Contour Silvertown (B), with much larger head diameter, provides room for its extra braking surface needed to stop a fast warplane quickly. It offers the advantages of both high pressure and low pressure tires, modified to meet military requirements of speed.



**♦ This test tells the tale.** The heavy road wheel on this machine is rotated to simulate landing speeds up to 110 m.p.h. When the desired speed is reached, air is thrust against road wheel and braking applied until it comes to a full stop. By timing this operation, the exact rolling distance can be found.

**♦ Note the wide footprint** and smooth, self-cleaning tread—both features of B. F. Goodrich Smooth Contour Silvertowns which assure maximum ground contact and stability.

*In war or peace*  
**B.F. Goodrich**  
**FIRST IN RUBBER**



Other films in the series, announced earlier, are "The Development of the De-Ice," and "De-Ice Servicing and Installation."

Other films in the series, announced earlier, are "The Development of the De-Ice," and "De-Ice Servicing and Installation."

[illegible]

**Back Construction Facemask**

The facemask is made of a specially formulated material and provides superior protection with a non-toxic surface which eliminates static electricity.

**3. Fully finished**  
at all times

Don't let these major stains and stains stain your wood. Use a hand saw to cut a piece of wood. The saw is shown in the process of cutting a piece of wood. The saw is shown in the process of cutting a piece of wood. The saw is shown in the process of cutting a piece of wood.



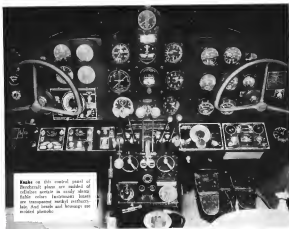
A small, dark, square photograph showing a close-up of a mechanical component, likely a valve or actuator, with various pipes and fittings.



Students  
but large  
more  
ready to  
to provide  
ment  
regarding  
to provide

**HOW TO ORDER**—All the De'lorr slide films and booklets are available without cost when ordered on your business letterhead. Address your inquiry to the B. F. Goodrich Co., Dept. 7189, Akron, Ohio. The booklets will be furnished in sufficient quantity for all members of your organization who might be interested. "De'lorr & Design" will be especially helpful to airplane manufacturers, designers and engineers, while "Developers of the De'lorr" and "De'lorr Servicing and Installation" will be of interest to everyone concerned with De'lorr operations, maintenance and servicing.

B. F. Goodrich  
Aeronautical Division  
Akron, Ohio



Panel B

By JOHN SASSO, Product Engineering

In strikingly increasing number, plastics are "taking to the air." This timely three-part article—dealing in turn with fundamental features, comparative properties, and principles of molding and design—provides pertinent data on the engineering and production of plastic components for aircraft.

1. Physical, thermal, chemical and chemical properties.

\* Based in part upon key chapters in the authors' new text, *Physics in Everyday Life*, published by The McGraw-Hill Book Co.

2. Design limitations of the plastic material, which relate somewhat to its physical properties but which to a great extent will depend on the method of production of the finished part.

3 Economy of production, which takes into consideration the cost of molds and tools, tooling, and expedited

quantity of parts to be obtained from the initial tooling

4. The cost of the plastic product in relation to other materials, considering advantages the plastic part may have in structural qualities, lightness of weight, and appearance.

The wide range of available plastic materials, many of which have special physical properties to meet certain application requirements, makes the choice of a proper material difficult. One method of classifying plastics is to divide the materials into thermosetting and thermoplastic groups. For purposes of definition, it may be said that a thermosetting material is one that under the application of heat and pressure polymerizes into a hard infusible product which will not soften to any extent.





This headlight cover on Curtiss P-40 is of formed Lucite, shaped to desired contour with heat via wooden dies.

as reheating and cannot be resoled and remolded. A thermoplastic material can be softened by heat and returned into solid state by cooling.

Because a material is thermosetting, it does not necessarily follow that it is particularly resistant to heat. Nor does it necessarily follow that because a thermoplastic can be softened by heat, it has no heat resistance. Working temperatures for such may approach 350 deg. F. At higher temperatures the thermosetting material may char, then decompose. The thermoplastic material will soften until that, then perhaps decompose if the temperatures rise high enough.

Most plastics are recognized in nature. They are derived from synthetic resins, cellulose derivatives, natural resins, and protein substances. So many types are available commercially that it is difficult to classify them simply. The accompanying list (Table I) covers only those plastic materials derived from synthetic resins and cellulose compounds. Groups not considered are the proteins (natural) and the natural resins (cellular, resin, asphalt, and pitch).

Basic materials for synthetic resins may be said to be coal, tar, cellulose, limestone, petroleum, salt, and water. From these basic raws are obtained, coal, acrylic acid, phenol, methacrylonitrile, styrene, methanol, formaldehyde, cellulose acetate, cellulose nitrate, ethyl cellulose, and many others.

The synthetic resins can be used with or without fillers, but they are usually compounded with fillers. The resins are available in liquid form for impregnating paper or fabric, for varnishes, adhesives, surface coatings, and the like.

Plastic resins are obtained from coal, which is distilled to produce an aromatic oil. Phenol is separated from the oil by treatment with caustic soda. Formaldehyde is obtained from the condensation of methanol or from wood alcohol.

Cellulose derivatives are obtainable from raw material. Cotton linters or wood pulp, treated with sulfur and acetic acids, then mechanically and chemically washed, then are subjected to an acid treatment to cellulose acetate resins. The cellulose resins are mixed with a plasticizer which is added in some cases to increase flow properties for ease of molding, added to others in various aspect strengths. These plasticizers include phthalates, phthalyl glycolates, and triphenyl phosphates. They have a marked effect on physical properties. Orientation, tensile and elongation properties decrease as increasing plasticizer content. As a result, the grades of plastic compounded for use of low wall show maximum strength properties, and vice versa.

#### Fillers

Added to resins, fillers make a wide range of properties possible. Various

fillers can be compounded with the resin to obtain special high electrical, chemical, and impact resistance, or to improve moldability. Typical fillers for phenolic resins used for rods, tubes, sheets, granules, and other forms. These resins are generally compounded with powdered wood cellulose (alpha-cellulose). Effect of fillers on properties may be easily seen by reference to our accompanying Table II.

Wood filler is the most common filler used in phenolic materials. This filler has a low specific gravity, therefore the number of loadings per pound is higher. Other advantages obtained with its use are good moldability, good appearance of the molded surface, and low heat conductivity. However, wood filled phenolics have only fair impact strength and are subject to shrinkage in service. Applications of the general-purpose wood-filled phenolics are limited by strength and heat resistance factors.

Carbon fillers improve impact strength and increase impact resistance. Though rag filler is generally required for higher impact strength, carbon black is widely used for its impact strength and cost strength. Pure made of carbon filled phenolics can be easily molded and polished, and can be molded easily—a important factor in maintaining high beauty production rates in compression molding operations.

Rag fillers increase impact strength, like asbestos depending on the length and type of fiber. Increase in strength is obtained at the expense of some other properties, notably poor moldability. Intrinsic parts cannot be molded easily of rag-filled phenolics because of the relatively poor flow of the material in the molding operation.

When heat resistance is paramount in the added part, asbestos fibers are compounded with the resin. Asbestos fibers also impart a good degree of water resistance, as well as resistance to most acids. These fillers compound with the molding operation because of reduced flow. Another disadvantage is the high specific gravity, which of course proportionately reduces the subject of parts per pound of molding material. (See data on specific gravity in Table III.)

Mica is used to impart good electrical resistance. It is the filler for low-loss compounds with excellent insulating qualities. Poor moldability is a characteristic. Because of brittleness, parts molded of mica-filled compounds cannot be drilled.

Glyptal fillers, generally used in combination with wood flour, asbestos, and rag, impart solid resistance and improve molding qualities because the glyptal resin is indolent. However,

	Tensile Strength (lb./sq. in.)	Compression Strength (lb./sq. in.)	Impact Strength (ft.-lb./in.)	Tensile Elongation (%)	Tensile Modulus (lb./sq. in.)
Phenolic (hard type)	4,000-10,000	10,000-20,000	10-20	2-5	10-20
Phenolic (soft type)	1,000-3,000	3,000-6,000	10-20	5-10	10-20
Cellulose (wood filler)	1,000-3,000	3,000-6,000	10-20	5-10	10-20
Carbon (rag filler)	1,000-3,000	3,000-6,000	10-20	5-10	10-20
Asbestos (rag filler)	1,000-3,000	3,000-6,000	10-20	5-10	10-20
Mica (rag filler)	1,000-3,000	3,000-6,000	10-20	5-10	10-20
Glyptal (rag filler)	1,000-3,000	3,000-6,000	10-20	5-10	10-20

Material	Specific gravity	Material	Specific gravity
Phenolic (hard type)	1.2-1.4	Phenolic (soft type)	1.1-1.3
Cellulose (wood filler)	1.1-1.3	Carbon (rag filler)	1.1-1.3
Mica (rag filler)	1.1-1.3	Glyptal (rag filler)	1.1-1.3
Asbestos (rag filler)	1.1-1.3		

good heat conductivity is noted. The filler is in phenolics for moldings of bearings, motor wheels, shafts, and the like.

#### Phenolic Resins

Phenolic resins are thermosetting in nature and in their final or cured form are inflexible and unchangeable. They are compounded with fillers and hardeners to give them the desired range of physical, electrical, chemical, and molding properties. The material is very easily used in industry. Cellulose fibers are generally used as a filler in industrial applications such as pump gears. They have long been used because of their possible luster, wide color variation, and easy machineability.

On the other hand, the molded parts have only fair moldability and are difficult to mold in variable sizes.

Molding materials are available in powdered, granular, or block form from

laminated and cast materials are available in sheet, rods, bars, and tubes. Molded phenolics are used for cases, bearings, wheels, motor housings, and auto housings. Laminated phenolics are fabricated into gears, bearings, and parts requiring electrical insulating characteristics.

#### Urea Formaldehyde

The urea formaldehyde plastics possess the unusual combination of thermosetting qualities with a wide range of uses, including many of the definite model plastics. Ureas have good dielectric qualities, good acoustic and thermal stability. Urea molding materials are available in powder or granular form and the laminated materials are available in sheet form. Urea moldings have been successful for such applications as instrument housings. Urea adhesives have been an important factor in the recent expansion of the physical industry.

#### Acrylic Resins

The acrylic resins possess some of the most desirable optical properties of the transparent plastic materials. Because of optical clarity, stability, resistance to weathering and moldability, acrylics have attained wide popularity as an organic glass. Basic acrylics are thermoplastic in nature; they can be easily fabricated into complicated shapes or forms where transparency and "light piping" are needed characteristics. Acrylic resins are available as molding powders or as cast sheets, rods, bars, and tubes. Typical applications include aircraft instrument enclosures and "altimeters," instrument dials and bezels, transparent housings, molded reflection, and the like.

#### Polystyrene

This thermoplastic material is noted for its excellent dielectric properties and optical clarity. The material is available in sheet form.



Light-piping characteristics of methyl methacrylate is utilized in the safety signal, which indicates if running light is on or off. Boat red, forward, with one, and blue, indicates light type from wingtip light, which may be variable in pilot.



# Aircraft Tool Planning

Part I

By RICHARD H. LUDERS, *Manufacturing Planner, Vega Aircraft Corporation*



Deepening cutter outlines crosshatched drill jig used at Vega Section is drilled in a complete run and crosshatched (full size) in finishing machine and final shop.

Vega outer wing leading edge steel assembly jig. Note work is more than finished by pinned struts and supporting bulk pick-up, corner plates at leading edge, divider and wing-line locators, leading leading edge rib locator support, and string stops on end plate.

Large scale production is largely a matter of good tooling which, in turn, depends on sensible tool planning. Proper job analysis is likewise essential to good tool planning. This article offers 20 essential points.



Further, with the United States at war, and warrent in demand, large scale production has come to the forefront industry. In the wake has risen the great need for tool planners, in manufacturing planning as they are sometimes called. These men, armed with the engineering points and pertinent information pertaining to the shop, customer and almost the knowledge of the special and standard facility two-way for manufacturing the airplane. They also coordinate the fabrication and assembly methods for the making of thousands of parts, subassemblies, major assemblies, and the final assembly of the ship. The entire program of tooling and assembly procedures must be prepared prior to, and coordinated with, production.

The tool planner, as an individual, must be experienced and technically equipped to meet such as requested or specified. He does not only realize the working of special tool orders to the leading shops, but also the working of shop orders (specimens shown) indicating the nature of the fabrication and

assembly lines in outlined, and possible necessary for the manufacturing of the parts or assemblies. As the tool and layout men are relieved, many problems come up pertaining to these tools and the methods of fabricating or assembling. With such a scope of duties, the tool planner continuously confers with the departments of engineering, lifting, stress, engineering and subassembly, tool design, tooling shops, fabrication and assembly lines, estimate production, purchasing, Army and Navy Inspection, storage, tool and parts inspection, etc.

Tool planning thus serves to the least of the aircraft industry, by translating the engineering blueprints into tooling and methods of manufacturing needed to create physically the airplane.

When a tool planner plans a job, whether a detail or assembly, he takes many factors and problems into consideration. He should consider the following: 1. parts. And after making such into account, he should plan the work according to the factors that affect the particular job at hand. Proper job

analysis is essential to good tool planning.

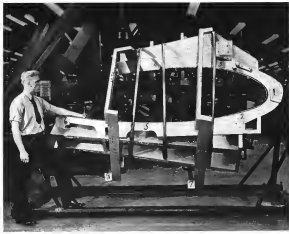
## 1. Ultimate Part Cost

The ultimate part cost, in most cost, is the most important controlling factor in the planning of any detail or assembly. If the parts are to be made, low cost tooling is necessary to hold down the cost of the part. If a considerable number of parts are made, more expensive tooling is justified. In planning the cost of tooling, then, is particularly only as to the number of parts made. There are a few cases where it takes expensive tooling to make the parts regardless of quantity. These cases are known as low and the bottom, as engineers are today, designing for production and not for just cost or two costs.

## 2. System of Classification

As an example, a combination of the four systems of classification (1) part size hole classification, 2 full size hole classification, 3 assembly size, or 4 as-

Wing center section master gage and check frame employed at Vega.





# Enlist GIRLS for MANpower in Your Screw Driving Army



## WOMEN DRIVE PHILLIPS SCREWS EASILY!

Now you can recruit women for pace screw driving army and be sure of fast, skilled work from the very start.

Big muscles aren't needed to drive Phillips Recessed Head Screws. Further, no special or mechanical aptitude... even novices produce without wobbly turns, slant-driven screws and slips that cause accidents or slow work.

Automatic cranking of the drive in the Phillips Recess makes such efficient use of turning power that screws snap up uni-

formly tight... with no little effort that workers mistakenly spend without using, hence and drive "become one unit," making driving as easy and foolproof as the work is greatly speeded up, regardless of the driving method employed. In most cases, power-driving becomes practical.

*They cost less to use!* Compare the cost of driving Phillips and slotted head screws. You'll find that the price of screws is a minor item in your total financing expense... that it actually costs less to have the many advantages of the Phillips Recess!

## KEY TO FASTENING SPEED AND ECONOMY

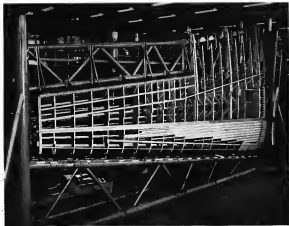
The Phillips Recess that was scientifically engineered to afford:

**Four Advantages**—Driver point automatically centers in the recess for steady, smooth and slant-free "become one unit." Fastening, usually more so than slotted.

**Power Driving**—Recess and power-driving are made practical. Driver won't slip out of point to insure uniform or rapid turn-out. (Average time saving is 50%.)

**Center Driving**—Turning power is fully utilized by automatic centering of driver to screw head. Workers maintain speed without drag.

**Better Fastenings**—Screws are crimped uniformly tight, without bending or breaking heads. A stronger, longer life screw.



Major steel assembly jig for outer wing panel. Your pick-up of others large line, main lines at ribbed and outboard end, leading edge of ribs into track and trailing edge ribs, and corrugated locations.

formly tight (Fig. 1) should be considered as per the experience of the detail or assembly, and also the number of joints or assemblies to be handled. For a small subassembly, one which is only a minor support or attachment and is to be attached to a large and more important structure, the detail may be assembled by means of pilot wire hole coordination. If a subassembly location is vital, and its details must be closely held with respect to each other, then full size hole coordination may be used. A less expensive means, if location of parts is important, would be the use of the assembly jig. If the same one should require close location, and a hole layout within an assembly which must coordinate for interchangeability to be other, then the assembly drill jig should be used. Further coordination will depend on experience, common sense, and complete analysis of the job.

**2. Attaching Points (Interchangeability)**—In assembling a set of parts for an assembly, the attachment points and attaching strips should greatly

simplify the process. There are important points of interchangeability. Whether the attachment of structure is made by means of two fastenings bolted together, or two or more fastenings attached to a common structure, the detail must be carefully planned. Fastenings at each point must be held very closely. The relation of these attachment points to their own assembly structure, as well as to the adjacent supporting structure must be held, and finally the detail that serves these points of attachment must be fabricated under close tolerances. Care should be taken to place master tools to perpetuate and check these attaching points.

## 4. Master Tooling

To build successful coordinated tooling and interchangeable parts or assemblies, a starting, or reference, point is needed. Just as photographic prints are made from a negative, so are various coordinated tools made from a master tool. A master template serves the layout as designated part engineering

and left, showing such reference lines as water lines, station lines, butt lines, and also the square (points or points) could have at that particular station of the ship. The drill jig template is a complete entire made from one of a series of coordinated jigs, or else made prior to the making of any jigs.

If the former is used, the template is used and drilled in the jig in a manner similar to that of a part. The template then serves as a hole layout around which other coordinating jigs can be laid, making up all or part of the work hole layout. If the latter should be used, the template may be made and shaped to the main reinforcing part (part) to which everything is coordinated and the hole layout established on it. All jigs are then laid out coordinated to this established source. Transfer plates are used much the same way as transfer forms because the holes are located in the jig or part transfer plate.

The Master Gage is a positive transfer tool which carries hole layouts for all parts (Part to page 304)

**PHILLIPS Recessed Head SCREWS**

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

21 SOURCES

Atlantic Screw Co., Philadelphia, Pa.  
The B. & B. Co., New York, N.Y.  
General Screw Co., Chicago, Ill.  
The B. & B. Co., New York, N.Y.  
The B. & B. Co., New York, N.Y.  
The B. & B. Co., New York, N.Y.

International Screw Co., Detroit, Mich.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.

Standard Screw Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.  
The L. & L. Co., New York, N.Y.



54



a certain pressure at 33.1 ft. per second.

#### Polarized Light

It was investigated whether polarized light would have an effect upon the observation of the phenomena. No such change was noted by varying the angle between the polarized and the analyzing set in front of the objective and the analyzing set in back of the jet.

#### Determination of Pressure

In order to determine the magnitude of the velocity of the air stream through the orifice, a pressure chamber was built with an attached pipe. The following Fig. 5 is a photograph of the arrangement as it is used to measure the pressure generated with the



Fig. 6. High velocity air stream hitting inclined glass plate (opened from side).

nozzle built of 135 lb. pressure was sent through a short straight pipe and into into the receiver shown in Fig. 3. The receiver consisted of a brass pipe 54 in. long. The connecting pipe to the supply valve was inserted exactly with this pipe. In order to keep turbulence to a minimum, this connection was made as short and straight as possible.

In the opposite end of the receiver, a conical hole was made with a No. 60 drill. This drill is the only one that just fitted into the hole of the air jet. It is reasonable, therefore, to state that the air jet photographed had a free opening of about 4000 in. dia.

By visually comparing the stream of air leaving the orifice on top of the chamber and the stream of air leaving the air jet, similar pressures are obtained under both conditions, provided the pressure is the same in every case.

#### Calculation of Speed of Air in Orifice

The following formula was used for allowing the relation between the pressure before the orifice and the velocity of the air stream within the throat:

$$V = \sqrt{2g \frac{K}{K+1}} P_1 S_1 \quad (1)$$

- $V$  Velocity at throat or orifice  
 $P_1$  Geopotential constant (32.2 ft./sec.<sup>2</sup>)  
 $K$  Adiabatic coefficient (1.41 for normal air)  
 $S_1$  Area of the orifice  
 $S_2$  Specific volume (volume/weight) (in ft.<sup>3</sup>)  
 $P_2 = (P_1)^{1/(K+1)}$  in the receiver (X)  
 $S_2 = \frac{1}{144}$  square inch hole in hole  
 $S_1 = \frac{1}{144}$  square inch hole in hole  
 $P_1 = 14.7$  lb./sq. in. (at sea level)  
 $P_2 = 14.7$  lb./sq. in. (at sea level)  
 $S_1 = 14.7$  lb./sq. in. (at sea level)  
 $S_2 = 14.7$  lb./sq. in. (at sea level)

The observation was made on the pressure at 25 and 30 ft. per second. Compared with the following velocities in the throat as calculated by the above formula:

- A) At 25 ft. per second,  $V = 1,003$  ft./sec.  
 B) At 30 ft. per second,  $V = 1,203$  ft./sec.

#### Critical Pressure

In the ordinary manner, the critical gas reading is determined as follows:

$$\frac{P_2}{P_1} = \frac{1}{3.5} \quad (2)$$

$$P_2 = \frac{14.7}{3.5} = 4.2 \text{ lb./sq. in. (at sea level)}$$

$$P_2 = 4.2 \text{ lb./sq. in. (at sea level)}$$

Critical pressure is 15.1 ft. per second.

Under the experimental conditions described, first visual observation of the phenomena was made at 30 ft. per second (not at 33.1 ft.). This, how-

ever, was too faint for photography. At 30 ft., a thin resistance stream is observed to leave the throat. No positive time individual streams could be observed at 30 ft. pressure.

At higher pressures the air stream becomes more noticeable. Moreover, the higher the pressure the broader appears the picture of the air stream. Last but not least, with increased pressure the segments start to separate from each other more widely. The optical stream lines seem to increase with increasing pressure.

In consideration of the fact that the critical pressure would be 15.1 ft. per sec., per reading, it may be stated, therefore, that the phenomena observed some time of the velocity of the air stream is of the magnitude of the velocity of sound in air (1,068 ft. per sec.). In fact, no flow patterns have been observed with this method at lower pressures, and, therefore, at subsonic velocities of air.

While the above method is particularly applicable to the examination of air streams of the magnitude of the velocity of sound in air, or higher such as occurs in projectiles, supersonic, etc., it may be extended into the range of lower velocities by increasing the difference in the refractive indices of the air stream and the surrounding media. Such a change would occur if vibration and temperature differences are existing between the temperature of the jet and that of the surrounding air.

Measure of heat of air (at a different rate) in a cool medium, or, in reverse, the flow of hot air in a heated medium, would offer facilities that would extend the method described into the range of lower pressures and thus subsonic velocities. In order to make visible phenomena below sound velocity and also in order to bring about convergent refractive and divergent properties there may be used instead of air, as such, a suspension of smoke and fog in air. This includes the use of oil vapors and discharges of explosives.

In the critical examination of the above values, attention should be given to the fact that all formulas among which are valid only for the velocity within the throat. They do not cover the velocity of gases after they have left the throat.

Yet there must be a difference in the relative velocities of air after the jet leaves the throat. This is necessary in order to explain the fact that there is more separation of the segments the higher the pressure of air and also the stream of air jet in order.

It should be noted in this connection that the gas pressures are approximately equal to the static pressure of the free velocity from static surface. This was definitely established by Bechthold



Fig. 11. Sketch of a hole.



Fig. 12. Air traveling past an object.

and Edwards.<sup>1</sup> Based upon this law is the Bureau method for determining the density of gases. It should be given consideration in the further development of the formulas employed.

The above-mentioned, therefore, should be considered merely as giving the order of magnitude of the velocity with which we are dealing. In this instance, both pressures being above the critical pressure, the velocity within the throat or orifice may fairly be assumed to be near the velocity of sound at the given set of conditions of pressure and temperature. The calculated values, which are theoretically identical and 1,068 ft. per sec. in both instances, are also enough to the 1,130 ft. per sec. sound velocity for a direct experimental and theoretical approach.

#### Effect of Greater Number

In addition to photographs of comparatively narrow air jets, as such, patterns were also made of broader ones. In order to make the latter ones, high pressure tanks were used for between the change of a nozzle's size. Studies of air streaming out from such a flat jet are seen in Figs. 4 and 7.

Fig. 6 shows air escaping from the flat rather tube at high pressure and thus velocity. And Fig. 7 depicts air flowing at low velocity out of the broader rubber hose and escaping upon a glass plate inclined towards the direction of the jet.

<sup>1</sup> Publication and Strength Patterns of Bechthold and Edwards, 1911, p. 101.

An extremely compact camera usually, as we have seen, is shown in Fig. 8. Here, it is interesting to observe that the air stream hitting the plate is apparently of higher velocity than this part of the stream which flows over the plate. No variations are visible in the latter part while the only divisions in the first part, which is closely adjacent to the nozzle, are clearly visible. Air impinging upon glass plates develops interesting patterns upon these plates. These patterns are hardly visible in transmitted light but are noticeable in the projection of the plates upon the screen with the optical arrangement referred to previously. These distinct patterns of air stream or oil vapor may have been retained in the phenomena associated and that this depends of oil films have been made upon the glass plate.

#### Working Hypothesis for Optics

The experimentally established necessity for either a convergent or an spread point source of light and the general arrangements in question leave about the probability that the observation of the phenomena in question is essentially based upon differences in the refractive index within the space through which the cone of light has to pass previously to its falling upon the projection surface.

Directly speaking, it seems reasonable to assume that this phenomenon can be observed only if the light comes from a point source whereby this point source is either a geometrically obtained pencil or an optically obtained concentration of a bundle of light rays in a similar manner. This immediately impresses one with the similarity of this arrangement with the case and in the study of interference phenomena.

No changes in the plane were observed, only black and white phenomena. These observations of interference phenomena were, therefore, not to have taken place at the phenomena under discussion. There is, however, good reason to assume a bending of the light rays. The reason for this is as follows:

As can be seen clearly in Figs. 3, 4, 5, 7, and 8, a duplicate corner of the jet is visible. The corners of the segments appear round. According to the refractive formula mentioned under the subcaption, Fig. 13, there should be sharp corners within the jet portions of the air jet, not round corners. These differences against the most recent straight law would be explained by a bending phenomenon.

In consideration of the fact that the density of the gas changes in the different parts of the jet, a refraction may take place in the different times. It seems permissible to assume that air

(To be continued)

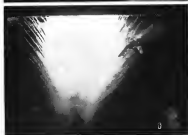


Fig. 5 and 10. Above is seen flow pattern of a narrow stream of air hitting a glass plate, while below narrow air jet hits glass plate under a 45-deg. angle (photographed through plate).

<sup>2</sup> E. E. Edwards, *Electromagnetic*, p. 204, McGraw-Hill Co., 1917.





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THE STORY OF TOMORROW



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FIELD SERVICE  
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## Photoprint Process Of Loft Layout Reproduction

By FRANK B. MARSHALL, President, Motorist Company

Accurate transfer of master drawings in any quantity to any material is here accomplished by direct contact photographic reproduction, with no distortion of lines. Relatively low in cost, this method makes for great savings in time and labor, gives precise quantity tooling.

**R**estorements of mold left layouts, drawings, and master boards without distortion of lines and with all data accurately transferred by some faster

means than the Japanese, time-consuming "lifting off the floor" by hand, has been a problem that has long challenged curatorial engineers.

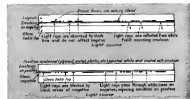


Fig. 1. Schematic diagram of (a) negative making, and (b) positive print making by the contact-grafting reflective method employed in the Photoplot system of making line reproductions of film targets, drawings, templates, and other subjects.

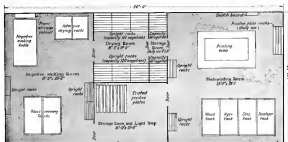


Fig. 2. Typical arrangement of photoprinting department as used by several aircraft manufacturers. Several installations are much larger than this.

paper or linen for blueprinting. Being a direct-contact reproduction, positive accuracy is achieved and broadening of lines is eliminated. Dimensional stability of the original is preserved, the possibility of human error avoided, and slow, expensive hand-copying is replaced by a quick, inexpensive process.

Supervisors can be trained in the spreading technique in a comparatively short time, and their assistants do not need to be highly skilled.

The process is photographic in that it involves sensitized negative and positive materials, exposure of these to light, and subsequent treatment in chemical baths to develop and fix the image. It differs from conventional photography in that no camera or lens is used. Instead, the negative is made by placing the emulsion side in direct contact with the surface of the original layout, blueprint, or other subject, and passing light through the negative (Fig. 1).



Fig. 3. Cross section of photoplastic printing table, showing order in which negative and positive materials are placed over high line.

This is reflection printing and is based upon the principle that light is absorbed by the dark surfaces (lines) and reflected by the light surfaces (background or field) of the subject. The positive print is made from the negative, the same as photographic contact prints are made from film negatives.

(requiring very little strategic materials and only ordinary carpentry), to provide a dark room arranged into three main departments. They are (1) Negative making room, (2) Photographic room, (3) Drying room. In the negative making room are light-proof paper storage cabinets, a large table, adhesive drying racks, glass recovery tanks, and an upright sink for glassplate storage. Across the center of the Photographic department are storage rooms and light traps on one side and upright drying racks on the other (Fig. 2).

Largest of the three sections is the Photoduplicating room, recommended size of which is 35 ft. x 38 ft. for the average volume of work to be done. In it is a large printing table with a light source below its center portion, covered with a thick plate of diffusing glass (Fig. 3). A rubber mat, or vacuum blanket, is arranged so it can be unrolled to cover this printing table com-

PHOTOPRINT PROCEDURE  
Followed by  
DOUGLAS AIRCRAFT CORPORATION

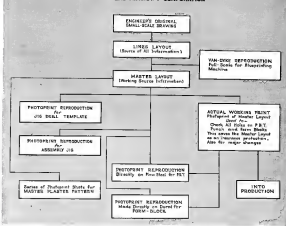


Fig. 4. Chart showing surface wave mode of photomicrograph in wing department of Douglas Aircraft Co's R. Segundo place.





**Fig. 3.** In photoprint process, silk screen is used to apply paper-adhesive adhesive to glass negative, to coat positive material with light sensitive emulsion, and to make positive material with a smooth coat of paint of uniform thickness. (This photo and those on following are figures by Consolidated Air Mail Corp.)

pleting during process. A bar connected to a motor-driven pump raises and lowers a vacuum under the rubber blanket, thus putting great pressure on the negative and subject.



**Fig. 4.** Adhesive, emulsion, and paint are forced through silk screen onto surface to be coated with a rubber vacuum.

An estimate based upon installation now in use puts the entire equipment cost at less than \$3,800 and copies of floor space at less than 1,700 sq. ft., for a department large enough to produce all the Photoprints used by an aircraft arm plant. Some of the largest firms, however, have installed departments custom-sized times that amount in order to produce exceptionally large quantities of the prints.

The negative plate is crystal glass or is, thick to which has been adhered

a sheet of sensitized translucent paper. Adhering the paper to the glass is simple, speedy operation. Perfect adhesion is secured through use of a developer which is not affected by water in the developing solution and does not allow the paper to shrink, stretch, or shift. This negative is ready, and it produces an undistorted copy of the



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**Fig. 7.** Sensitized paper is applied to reflective-coated glass plate in two layers, using a special mangle which permits measurement of area exposed on paper roll. Complete adhesion and freedom from wrinkles are essential.



**Fig. 8.** Rubber vacuum blanket is then applied to cover plate and table. When air is exhausted, surfaces of negative and layout are brought into close contact under great pressure. This step uses vacuum or breathing of lines.

AVIATION, April, 194





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Fig. 9. Light box color photograph table contains a molecule of easily traced glasses. Light is evenly diffused by a plate of ground glass at this table. Exposure is controlled by automatic timer.



Fig. 10. Removing exposed negative from developing tank. Both negative and positive photographs are developed and washed in same manner as in ordinary photographic printing.

material is represented in, white lines on a black field. After use, the paper is removed from the glass exactly with a solvent so the glass can be used repeatedly.

Any suitable or desired rigid material can be substituted to form the positive plate. When plywood is used, it is first dipped in a waterproofing resin bath to protect it from the developer and washing solutions. It is smoothly coated with flat white paint, squeezed on through a silk screen, so the ink to be registered. Metal sheets also are painted in this manner before use. The white paint screen coated material with the black lines of the desired Photostat and provides a good, smooth surface for drawing with pencil, ink, silver stylus, or scribe. The paint and mechanism of the Photostat lens do not chip away or burn and disintegrate during coating, printing, drying, and handling operations.

Procedure followed by Denison Aircraft Co. (shown in short form in Fig. 4), indicates the many uses of Photostat in building. Photostat representations of the master layout are made upon various material and from them are produced the jig drill templates, assembly pan, master glider patterns, form blocks, and pressure forming templates. While data is shown as the material from which form blocks are made, other uses of this process employ hard wood in many cases.

A feature of the greatest importance in the Photostat method of reproduction

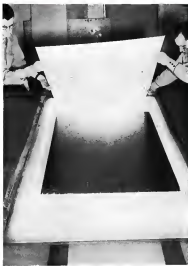


Fig. 11. Finished negative is here shown over light box while a sheet of sensitized metal is laid upon it for making a positive gliderform. In usual practice, this step is done with web and (left) light of data room lamp.





Fig. 13. Here, Photoprint reproduction of a master template is being cut out. Note that all data is reproduced on print. A special gauge and cushion which does not chip away, here as in color in cutting is used to cut positive material. (This photo and those in remaining slide figures by Douglas Aircraft Co.)



Fig. 12. Elements cut out of photoprints (except vertical housing differences) are here being positioned on an overall master template in preparation for building up a master plastic pattern. This master exact positioning and dimensions around layout.



Fig. 14. Building up master plastic pattern. Even scrap templates used in shape patterns are made by cutting out plastic prints.



Fig. 15. Photoprint as dorsal form block material as used by Douglas Aircraft Co. Form blocks are also for all wood or other materials. Note that all data and hole locations are shown.



Fig. 16. Cutting out form block.



Fig. 17. Form block cut out, ready for breaking and mounting of location pins.



Fig. 18. Shaping finished form block against a Photoprint of original data layout. This Photoprint is used as actual working print, and its use in shop prevents damage to original layout.

Fig. 18. Finishing a dorsal form block made from a Photoprinted block of wood.



photographing directly upon sensitized form block material eliminates the need for a form block template, as all information appears on the form block itself and the correctness of the shape

is assured. Also, both reproduction shown and opposite reproduction can be made on form block material from a single-hand exposure. Having the shape and data on the form block facilitates

checking it with the actual working print, since the two images can be placed in actual position and quickly compared, regardless of open or closed bench.

Fig. 20. Finished dorsal form block, ready for production run.







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# Design Considerations For Plywood Structures

## Part IV . . . Wings

By L. J. NARHOEFER, Chief Engineer, Ford Research Corporation

Advancing beyond primary considerations of weight saving, this engent discussion of innovations in wing design gives attention to economy in both materials and labor . . . Fourth in the author's selfless series on basic factors in the design of plywood aircraft structures.

TAKING the development of aircraft wing structure design from the time of Charles to the present, it is apparent that the current system of rib-spar grids was followed by Doudar and has subsequently been subjected to a series of refinements and modifications as materials and wing sections have been improved.

Originally a single framework area which failed under a twisted test, it has itself readily to design approximations of accuracy equal to the then-current knowledge of aerodynamics and air forces, and it was relatively simple to construct when the final surface was fabric.

Necessity of more substantial covers has been dictated by our higher speeds, resulting in the use of metal and plywood skins. Aerodynamic refinement has required the present smoothness and flat-surfaced parts, with a minimum of wrinkling and bending during normal cruise operation. The study

of loading phenomena in metal sheet has led, in turn, to the use of closely spaced stringers and supporting ribs and has increased constructional efficiency. No dependence of the material and size of the design is possible in view of the fact that while wing loadings vary from 4 to 35 lb. per sq. ft., the wing weights vary from 15 to 35 lb. per sq. ft. The additional size to design with increasing loading is obvious.

Refinement of design has led to a practice, in metal structures, of using the sheet with large numbers of small stiffeners. The resulting increased labor required for assembling because of increasing importance at times when manpower shortages plague the industry. In more normal times the increased size of aircraft dictates the necessity of reducing the cost.

Enumerate the detailed reasons for the use of the rib-spar grid with metal or plywood cover, the following consid-

erations immediately present themselves:

1. Stresses of different parts requiring separate tools and manufacturing facilities.
  2. Close tolerance necessary on each part in order to permit assembly.
  3. Cost of assembling grid system.
  4. Inadequate joints necessary when structure is closed with metal cover.
  5. Large numbers of joints required.
- The above is by no means a complete list, but it illustrates the outstanding hazards to the path toward reduced labor hours for an assembled wing. The at least consideration of the possibilities of reduction is advisable in thought under the fact that labor per pound of material rises in the neighborhood of 5 lb. on medium aircraft as compared with automobiles at 4.17 lb./lb. This, then, is one of the listed factors which will be promptly reflected in increased production and lower labor requirements.

### Simplified Mated Structures

Recognizing that major changes in methods and arrangements are most readily accomplished simultaneously with the introduction of new processes and materials, a sincere effort has been made not only to derive structural arrangements designed to welded plywood but to develop simplified assemblies. Some arrangements toward changing the structural arrangements was afforded by the early wing structure tests, results of which were expediting but obscuring. The first serious efforts toward wing design were guided by the then-popular metal structures, consisting of a single box type strength member with straight leading edge and trailing edge forming pieces which incorporated sheet-metal ribs (see Fig. 1).

Each of the three pieces was mated into a portion of the structure with its flanges, ribs, and stiffeners engaged. The ribs themselves were mated and then held together in an assembled unit by making the wing skin into place. The beam portion of this wing was a place-scraper box combination with varying skin thickness, mated in structural parts with a gently curved, "thick, sweet and lean." When it got down to actual static tests, some guess for reflection was occasioned.

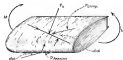


Fig. 2. (left) Consideration was given to feasibility of using bonded sheet ribs as a leading edge, and wing at this stage of design was then followed as shown. Fig. 2a, (right) designates the forces.

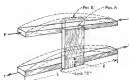


Fig. 3. Spreader ribs compresses flange to increase force and stabilizes compression side of shell against buckling locally or as a whole. Deformed ribs are shown under load in compression, after in tension. With employment of high "C" section ribs developed tests to hold member straight into article.



Fig. 4. With highline wing, forces were referable to the system of a single strengthened by a composite force. Theory of existence of tension stress being borne out, reducing to increased substantially.



Fig. 5. Consideration of Douglas wing. All parts are subject to internal design, with attention of required bending strength and rigidity of skin about its open side.

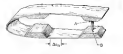


Fig. 6. (left) Typical cantilever construction on single beam and mated complex with collectors and ball leading edge.

Fig. 7. (right) Typical cantilever construction on single beam and mated complex with collectors and ball leading edge.



Fig. 8. First aircraft efforts toward wing design were metal structures consisting of single box type strength member with attached leading edge and trailing edge forming pieces which incorporated sheet metal ribs.

During this period it was possible to view the matter in retrospect and to realize that no matter how simple parts might be constructed, the number of parts made a definite and measurable contribution to the cost of the final

piece. It was also of note that parts and fittings could hardly be as expensive as the parts being joined.

Confronted to an extreme of simplicity, the final expensive wing structure would be a poured material permitted

to solidify in a preformed mold in which all fittings are reduced to a minimum and those determined as unavoidable held in position until the poured material solidified and sustained them in place.





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**Fig. 7. Early wing construction.** Validated from forward flange to fuselage rear end.



**Fig. 8. Here, outer shell, molded as an "inside"**



**Fig. 9. Intermediate construction** shows how to conform to that in Fig. 7, except that flange is wide and welded in center.



**Fig. 10. Alternate sketches for intermediate method of wing**

### From Web and Rib Function

The structural material at hand being available and its stiffness too dense to permit use of a solid wing, we turned next to examination of the function of the rib web and spar web with a view to their replacement as skin-layers. Rib webs are utilized to maintain the surface contour, transmit the load air loads to the main structural members, and, additionally, serve to resist the torsion. In a monocoque shell these webs perform the additional function of acting as support members insuring the integrity of the tension and compression flange material in shear together.

Elimination of either the rib web or the beam web offered a possible simplification and could result in the elimination of the parts themselves. The connection of the rib and beam webs presents a construction problem which adds in no small measure to the cost of the wing, and any feasible method of reducing or simplifying the cost of two webs is in itself worthwhile. The forward spar web is a tension wing, when considered as a shear flow part, a reinforced web with the continuous nose shell.

Having observed that the postulated wing it was not usually feasible to construct a sufficiently thin web to achieve bending throughout its length, consideration was given to the feasibility of using the forward shear web as a leading edge. The wing at this stage

of the design was then a hollow tube as shown in Fig. 3.

It was possible to introduce ribs for all parts, with the exception of the shell thickness necessary to resist local distortion due to local air loads and wing deflection. The latter had to be, in general, equal and opposite on the tension and compression sides of the shell, any spar web would serve the function of providing a complete flow path. The problem of ultimate loading of the compression material was also answered by the spar web.

### Compression Flange Bending

Reinforcement of the compression side of the shell against buckling locally or as a whole is provided by this same spar web. The reality that taking the compression flange to the tension flange would provide such stiffening has been proven by test and is substantiated in the following study.

Let us consider two members such as depicted in Fig. 3, the one loaded in compression and the other in tension. In order for the compression strut to fail as a column it must depart from position "A" to position "B". If the center of the two members are connected by a link "C", the tension strut will then experience a force tending to draw it from its normal position and a restraining force will develop due to the tension loads "D" tending to hold the member straight. Evaluation of this restraining force is a mathematical

problem of some complexity, here it is a function of the working flange. Fortunately, in the case under consideration of a hot-rod horn of sufficient strength to cause trouble and the design of the two to carry the loads applied loads are provided sufficient strength for the buckling air well.

### Re the Spine Wing

A spine wing off construction as this theory has provided evidence that the principle of stabilizing the compression flange by tying it to the tension flange is true, even though only a differential compression exists on the two flanges. In this instance, due to the external lower side, the loads on the portion of the wing shell in the bay were all of compression and bending type, with the bending moment of insufficient magnitude to produce moment tension stresses. It was possible to weld the two flanges into a continuous member, but the forces were undesirable to a certain (Fig. 4) consisting of a couple accompanied by a compressive force and that because of the nature of the theoretical tension stress the stabilizing was void function. This theory was borne out adequately, and, it must be confessed, surprisingly, by the first test of the cell.

### Shear Stress Compression

Returning to the wing shell (Fig. 5) it is apparent that all parts are subject to unusual design, with the exception (Turn to page 360)





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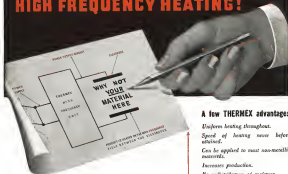
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## Theory and Technique Of Perspective Projection\*

### Part III

By GEORGE F. BUSH, Assistant Professor of Graphics, Princeton University

Increasingly favored on aircraft production lines, perspective engineering illustrations are both supplementing and replacing ordinary blueprints—thus creating a wide demand for personnel trained to make these drawings. Third of a series on graphical projection, this article details Basic Superposition three-point perspective.

PERSPECTIVE ENLIGHTENS and clarifies misleading scientific, oblique, and perspective projections. More, generally, been found significantly superior to conventional orthographically projected engineering drawings, when shape design is in mind. Evident shape and basic component parts of an object are revealed at a glance through these pictorial presentations, and little or no tracing is required to read them. Hence, the greatest advantage of perspective projection.

Having detailed the introductory principles and one-point perspective in Part I of the series (page 116), the Author and two-point perspective including surface vanishing points and reduction and enlargement in Part II (page 80, *See Author*) we will now describe three-point perspective and the Basic Superposition Method. For details of Methods 1 and 2 and Principles 1 and 2, dealt with in the following explanation, see page 124, Part I, *See Author*.

To begin with, the three-point perspective is that obtained when none of the three principal axes of the object is parallel to, or in, the PP, as in Fig. 14. Then, as the right view is drawn, PP makes an angle of 45 deg. with the GP axis, which the last view, with the vertical edge GP, the second to PP. As the auxiliary view over the right and view will show, the box has been rotated in a plane parallel to the GP through an angle of 20 deg. for simplicity.

The perspective obtained will be a half-view view of the box, as the view as seen in the eye at GP, with GP being somewhere near the center of the perspective so that most of the right face are within reasonable proportions.

\*A book, *Engineering Drawing*, is being prepared to find final set with illustrations.

tion of three-point perspective is original with the author and represents a simplification over previous methods in points of time required and the number of complete lines necessary. This is due largely to the fact that the PP, as the top and end views, has been made an edge view. This, of course, requires a sloping PP and GP, since the angle between either of these two and the PP is, as the particular instance, 45 deg. If the GP and PP are kept horizontal and the PP made to slope at the required angle, a second type of projection obtains. The author's second type, although involving a sloping PP, as in the former, conventional method, will differ after that by another original contribution of the author's in respect to the manner in which the peering points, by the right lines of PP, are obtained.

When the object has maximum lines in its various parallel face sets, a combination of Methods 1 and 2 may be achieved, although it must be emphasized that the advantage of the combination over Method 1 is not great. For purposes of illustration, the combina-

tion of three-point perspective is original with the author and represents a simplification over previous methods in points of time required and the number of complete lines necessary. This is due largely to the fact that the PP, as the top and end views, has been made an edge view. This, of course, requires a sloping PP and GP, since the angle between either of these two and the PP is, as the particular instance, 45 deg. If the GP and PP are kept horizontal and the PP made to slope at the required angle, a second type of projection obtains. The author's second type, although involving a sloping PP, as in the former, conventional method, will differ after that by another original contribution of the author's in respect to the manner in which the peering points, by the right lines of PP, are obtained.

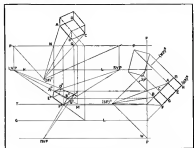
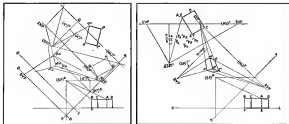


Fig. 14 Three-point perspective (front edge behind plane plane) by Method 1 and 2 (both Type I) half-view view.

**The GIRDLER CORPORATION**  
Thermal High Frequency Dielectric Heating Equipment  
THERMEX DIVISION - LOUISVILLE, KENTUCKY





Figs. 12a (left) and 12b (right). Three-point perspective (front edge behind picture plane) view of Type 1 and working into the perspective method, bird's-eye view.

tion of Methods 1 and 2 will be used here.

Referring to Fig. 14, the location of  $SP$  in the top and end views is assumed and  $PP$  shown in all views as an edge, i.e., it is perpendicular to the plane of the paper. Obviously,  $GP$  and  $HP$ , which are parallel planes, will slope up and right in the end view and their intersections with  $PP$  will be the lines  $GL$  and  $HL$ , respectively. The intersection of the plane  $T$ , containing the top of the box, with  $PP$  gives the line  $T$ . This is the line in  $PP$  from which the horizontal lines in the top of the box, containing lines like  $AB$ , will be drawn in perspective to either the  $LPP$  or  $RPP$ , as for  $M$  ( $LPP$ ). Perspective of corresponding lines in the bottom of the box will be drawn from  $GL$ . The determination of  $LPP$  and  $RPP$ , by the author's type of projection, is obvious and represents as new procedure as would be necessary by use of previous

conventional methods. Outlining the complete projection:

1. Locate  $LVP$ ,  $RVP$ , and  $DVP$ , as shown.
2. Locate the perspective containing  $AB$ , i.e.,  $M/LPP$ , as shown.
3. Locate  $A'$  on  $M/LPP$  by using the vertical from  $T$ , which was found in the plan view of  $PP$  by the right line ( $SP$ )/ $A$ . Check this location of  $A'$  by using the end view and Method 1. Similarly, locate  $B'$ .
4. Draw  $A'B'$  and  $B'E'$ .
5. Find  $C'$  on  $B'E'$  by using a line from  $Q$ , which was found in the plan view of  $PP$  by the right line ( $SP$ )/ $C$ .
6.  $GP$  is where line  $C'(LPP)$  intersects the line  $A'B'E'$ . (Check this location with Method 1 or 2.)
7. Find  $C''$  by Method 1. Check to see that it lies on  $B'E'$ .
8.  $G''$  is the line of intersection of line  $C''(RPP)$  and  $C'(LPP)$ .

Fig. 14. Three-point perspective (front edge behind picture plane) by Method 1 and 2 (both Type 1) working into view.

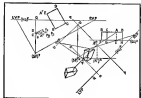
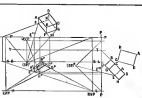


Fig. 15. Three-point perspective (front edge behind picture plane) by perspective method, working into view.



# Immediate Conversion TO Speed Nuts



Speed Nuts are made in many sizes and shapes to meet your needs. They are made of steel, aluminum, brass, and other materials. They are available in many finishes, including painted, polished, and anodized. They are also available in many sizes, from 1/8 inch to 1 inch. They are made in many shapes, including round, square, and hexagonal. They are made in many materials, including steel, aluminum, brass, and other materials. They are available in many finishes, including painted, polished, and anodized. They are also available in many sizes, from 1/8 inch to 1 inch. They are made in many shapes, including round, square, and hexagonal. They are made in many materials, including steel, aluminum, brass, and other materials.

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You can now convert to SPEED NUTS to help meet your production schedules. ON LINE SPEED NUTS are approved by the U. S. Army Air Forces and the Bureau of Aeronautics for non-structural attachments on military aircraft. They are also used on jeeps, trucks, tanks, F. T. boats and other war equipment.

This provides a more abundant source of approved self-locking nuts to relieve the present shortage.

Our Engineering Dept. will be glad to assist you in determining the proper approved locations where Speed Nuts may be used. Request for information or assistance will receive immediate attention.

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Speed Nut System



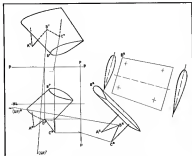


Fig. 18. Geometric perspective (true/eye view) of wing-up mechanism of Consolidated PBY flying boat by Method 1, Type 2.

the point above a horizontal through  $(RP)^1$  across  $PP$ . Also locate and draw  $OD$  and  $OL$ .

2. Locate  $LTP$ ,  $BTP$ , and  $GTP$ . For example,  $(LTP)^1$  is on  $(ML)^1$  at a point where a horizontal sight line from  $(LTP)^1$ , parallel to  $AB$ , meets  $PP$ .  $(BTP)^1$  is directly below on  $(BL)^1$ .  $BTP$  is found through a line from  $(BTP)^1$  parallel to  $CD$ ;  $GTP$  through a

vertical line from  $BP$ , parallel to  $AB$ .

4. Find  $A^1$  by Method 3, i.e., from the points on the top and end views where sight lines to  $A$  across  $PP$ . For example, in the end view, this is  $(A^1)^1$ , which is also on  $(RP)^1$  (top view). To find  $(A^1)^1$ , first lay off  $(GTP)^1$  from  $(RP)^1$  along  $(RP)^1$  to obtain  $(A^1)^1$ , second, a line parallel

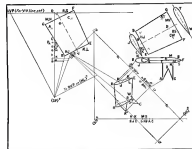


Fig. 19. Geometric perspective (true/eye view) of wing-up mechanism of Consolidated PBY flying boat by Ray-Superposition Method.

to  $(BL)^1$  from  $(A^1)^1$  intersects  $(RP)^1$  at  $(A^1)^1$ . Third, a line from  $(A^1)^1$  perpendicular to  $(BL)^1$ , intersect a line from  $(A^1)^1$ , perpendicular to  $PP$ , at  $A^1$ .

5. By using step 4, other points, if necessary, can be located by Method 4. Method 2 may be combined with Method 1 to find the complete perspective shown.

In three-point perspective, Type 3, as illustrated in Fig. 15a, the top view of the object is not in its actual position relative to the end view, as it normally is on an engineering drawing using orthographic projection. To draw the perspective from such a normal engineering drawing, a piece of tracing paper or cloth may be laid over, suspended, on the drawing and the top view of isograph of the points, where the right lines across  $PP$ , may be obtained as the paper is in the above procedure, and is indicated in Fig. 15b. The tracing paper is then moved over the drawing so that its  $(RL)^1$  matches  $(BL)^1$  located previously on the drawing by being over, on its end view,  $PP$ ,  $(RP)^1$ , etc.

In this matching process, it is well to remember not to have the central perspective overlapping line and view, even in part. Note that distances like  $(RP)^1$  or  $(A^1)^1$  may all be laid off at one time along a paper straight edge, then all laid off at one time along the line  $(RP)^1$ , as the  $A$ ,  $B$ ,  $C$ , and  $D$  in Fig. 15b, so that by horizontal projection the points like  $(A^1)^1$  may be located all at one time. With the tracing paper in this new position, the procedure is the same as that outlined above for, and as indicated in, Fig. 15a.

With this procedure, orthographic engineering drawings may be used, without splicing them, to obtain even the most general common perspective on a piece of tracing paper or tracing cloth. It avoids the mess of an arbitrary accommodation to those with no "artistic ability." An impatient art director now looks immediate and easy expression on a technical, exact, and technical basis. Those who previously could not find a good likeness will now be able to get the exact likeness, or enough basic points to create an exact likeness, by the above method.

Comparison of the various methods and types discussed will indicate that a combination of Method 1 and 2, Type 2, and the superposition method of the author's, is in general the best method for obtaining a three-point perspective from conventional engineering drawings using orthographic projection. Although Type 1 involves a simple method for locating the  $PP$  (vanishing points, the top view of the object must be redrawn in its actual position. Type 2 re-

(Turn to page 365)

## INSIGNIA OF THE U. S. MARINES





# Report of 38th SAE Meeting

IN WAR OR PEACE  
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THE LOUIS ALLIS CO., MILWAUKEE, WIS.



Army member of SAE's aeronautical board, Col. Dave Lingle, shown with Post Pres. Arthur Nutt (left), vicepresident and chief of engineering of Wright Aeronautical Corp.,

Mac Short of Vega, society's newly elected president, and his predecessors, Arthur W. Herrington, chairman of Marine Herrington and a director of Consolidated Aircraft

**Aviation men focus attention of their automobile allies on aircraft production, plane testing, and engine construction and operation. Mac Short, of Vega, starts his term as new president.**

**A**S THE LIMITED automobile and aviation industries continued to pour out planes and parts around the clock, further evidence of the strength and purpose of the alliance between men

in these once-separate fields was provided in the 38th Annual Meeting of the Society of Automotive Engineers, held this year in Detroit.

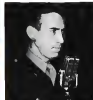
As previously reported, the new president elected for the coming year is Mac Short, veteran of the last war's U. S. Army air service, former Mass. executive institute of Technology is aviation, organizer of the Vega Aircraft Corp. in 1935, and vice-president in charge of engineering of the Lockheed Vega amphibious which produced the Hudson bomber. He is the first plane builder ever to direct SAE.

Besides Mr. Short, other aviation men elected vice-presidents were John

G. Lee (United Aircraft Corp.) to direct the aircraft division and S. K. Hoffman (Aviation Corp.) chairman of the aircraft engine section.

In his inaugural address the new president reminded his fellow members that the cooperation which has multiplied aircraft production should not be allowed to breed fears of post-war competition. "In the main I think the airplane companies will continue to produce planes, and the automobile companies will make cars," he said. "Both will stick to the work in which they are naturally successful."

The 1,000 engineers who heard this (from page 104)



Col. E. B. Holliday presents his analysis of the comparative efficiency of aircraft and automobile systems.



In his home city, E. W. Austin (left), chairman of the SAE Detroit section, plays host to George T. Mason, president of Nash-Kelvanator Corp., and Carl Boes, executive engineer of Chrysler Corp.



# Too Bad, Tojo

• Too bad for you, Tojo. You thought it couldn't be done. You guessed wrong. You forgot to reckon with the speed and adaptability of American industry to pitch in and supply our fighting men with equipment far superior to that of yours.

Here at The National Bronze & Aluminum Foundry Co., just one of the many thousand companies, producing for United Nations' Victory, special care is taken to see to it that every casting is of top-notch quality. Take this illustration for instance, it shows a casting going through rigid X-ray inspection. And when X-ray inspection is necessary, it receives the same minute care taken in all other operations in the production of National Steel and Permanent Mold Aluminum Castings.

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## Proper Care of Compressed Air Plants

By ED C. POWERS  
Compressed Air Editor

Compressors of all types have such an important part in all industry today that the WFS has allocated their purchase and production. Points covered here by a member of the Institute will help you get more out of your compressors.



Fig. 2. Casting water discharge.

In the case of the waste of a compressed air station—compressors, air lines, machinery, accessories, and instruments—certain fundamental precautions must be observed for efficient results and long life of the equipment.

When starting a new compressor, or one which has not been in use for a time, see that the crankcase is thoroughly drained of dirt and foreign material and that it is filled to the proper level with oil. Crankcase lubricators should be cleaned and filled with oil suited to cylinder lubrication. Verify the lubricator, pistons, or other suitable petroleum, so does valves and cylinders. They have exposed explosion in subsequent operation of the compressor. There are should

be prohibited. In starting, be careful of hot deposits which may clog oil lines.

Above all, make certain that the outside free has been blown out and thoroughly cleaned of dirt, welding slag, scale, and grit. Many new compressors have had their valves and cylinders badly damaged by working in such material.

To make sure that all parts are clear before starting, the machine should be turned over a few times by hand. If the source of power is steam, drain the steam cylinder and steam pipe above through line be opened to clear the condensation. Power should be turned on gradually. With steam, the discharge

should be opened slightly to test cylinder. After this, it may be opened enough to turn over the compressor slowly. With single crank type, it will be necessary to turn it over beyond dead center.

Careful check of bearings and oil supply is required during first few hours. It is good practice to run in a new machine with compressor valves, treated to allow working in under no load. After several hours operation they may be replaced, making sure the new valves hold the valve—usually normal. Pressure should be built up slowly.

Soaking hot packing needs through at operation. If hot packing is used,

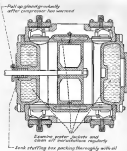


Fig. 1. Cross section of compressor cylinder and piston.

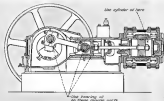


Fig. 3. Compressor and power unit.



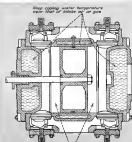


Fig. 4. Cross section of compressor cylinder.

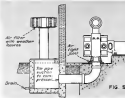


Fig. 5. Diagram of intake installation.

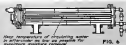


Fig. 6. Sectional view of aftercooler.

working in of water might be allowed. The packing seal should never be too tight as starting, for this may wear the piston rod. After compressor has warmed up, the packing should be tightened just enough to prevent blow-by along the rod (see Fig. 4).

The cooler system should be checked for leaks before start-up, and the packed area is examined that water flow is suitable, either into an open tank or the discharge (Fig. 4) or through pressure gauges in a closed system. Circulating water lines require drains at their lower points, both for cold weather protection during shut-down and for cleaning and flushing.

It is essential to examine and

clean water jackets at frequent intervals (Fig. 4). Their condition is a good indicator of the condition of water used. Heavy deposits of hard scale form an insulation which reduces cooling efficiency.

Cylinder	Piston	Best	Old	Old
per	per	per	per	per
Cu	Cu	Cu	Cu	Cu
Inch	Inch	Inch	Inch	Inch
per	per	per	per	per
min	min	min	min	min
1/8 in.	1/8 in.	1/8 in.	1/8 in.	1/8 in.
1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.
3/8 in.	3/8 in.	3/8 in.	3/8 in.	3/8 in.
1/2 in.	1/2 in.	1/2 in.	1/2 in.	1/2 in.
5/8 in.	5/8 in.	5/8 in.	5/8 in.	5/8 in.
3/4 in.	3/4 in.	3/4 in.	3/4 in.	3/4 in.
7/8 in.	7/8 in.	7/8 in.	7/8 in.	7/8 in.
1 in.	1 in.	1 in.	1 in.	1 in.
1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.
1 1/4 in.	1 1/4 in.	1 1/4 in.	1 1/4 in.	1 1/4 in.
1 3/8 in.	1 3/8 in.	1 3/8 in.	1 3/8 in.	1 3/8 in.
1 1/2 in.	1 1/2 in.	1 1/2 in.	1 1/2 in.	1 1/2 in.
1 5/8 in.	1 5/8 in.	1 5/8 in.	1 5/8 in.	1 5/8 in.
1 3/4 in.	1 3/4 in.	1 3/4 in.	1 3/4 in.	1 3/4 in.
1 7/8 in.	1 7/8 in.	1 7/8 in.	1 7/8 in.	1 7/8 in.
2 in.	2 in.	2 in.	2 in.	2 in.

Oil flow rates are based upon 2,000 drops per gallon at 100 deg. F.

check joints may be closed by a pressure put on the seal and supports, or by clamping (10 percent headpressure or more) for hard scale. This can be forced through joints with a small air cylinder pump, or run through from a container placed above the cylinder. It is important to maintain seal in the joints with an alkali after cleaning to prevent leakage.

In the operation of two stage compressors, discharge of air must maintain pressure in one of the first sections of trouble. If atmospheric pressure rises, there is something wrong in the high pressure cylinder, such as leaking or broken check valves or defective piston rings. If atmospheric pressure falls below normal, trouble may be located for in the low pressure cylinder. Such a defect may also be indicated by overloading of either discharge or intake valves.

If valve covers are unusually hot, it means leakage either in the valve or through a blown or gasket between valve and cylinder. Particular care should be taken to prevent loose valves, since very slight gaps can cause leakage of valve seat, dropping parts in the cylinder and causing serious damage.

On the subject of lubrication, first class specification of the manufacturer. Air motor or three types of oil may be required by a compressing component—one type for the compressor cylinder, another for the drive gear, a third (This is page 200)



Loaded Aircraft Photo

## This Bomber needs its tail surfaces—its small electric motors are essential too!



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Electric accessory motors are almost as important to today's military aircraft as tail surfaces or landing gear. For example, Bodine aircraft motors are widely used in modern bombers to operate doors, antennas, trim tabs, fuel pumps, transfer pumps, propeller fasteners, and many other accessories.

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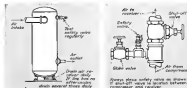


Fig. 7. Receiver fittings.



Fig. 8. Safety and shut-off valves.





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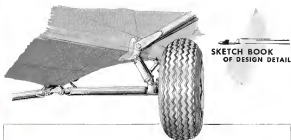
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Assembly break-down and detail drawing of landing gear control unit on Avianco T-12 Training Glider, which was developed in many ways from the standard Avianco "Hydromatic" planes. Note that landing struts for glider version are same as those utilized in power plane. Removal of propeller permits use of short landing gear strut, which brings landing gear in ground in keeping with conventional glider practice. (For details on new version design, see Avianco's Sketch Book, Jan. Oct., 1932.)



Forepart of the Boeing B-27V dorsal fin, which imparts much of the flying Fortress' stability at high altitudes. It is designed for constant protection as well as strength. Longitudinal struts are first attached to the vertical ribs, then aluminum alloy ribs are added to place in complete this section of the fin.





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Aeroquip detachable hose fittings simplify field hose replacements by reducing the thousands of combinations of sizes and lengths of hose lines to dozens of fittings and sizes of hose. These detachable hose fittings are instantly re-usable with new Aeroquip hose for hose line repairs. These are fielding advantages for our air forces.

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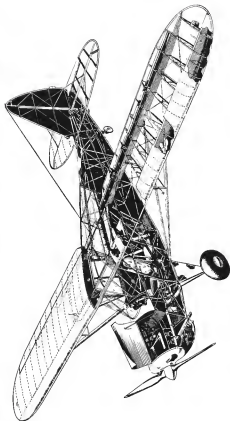
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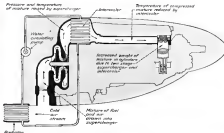
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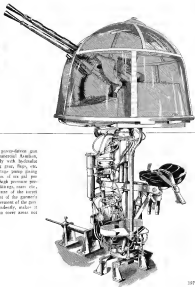
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Above, diagrammatic layout of two-stage supercharger as installed on Rolls-Royce Merlin II engine, power plant of the new British DC high altitude fighter, and to maintain desired pressure up to 3000 lb., where charge is compressed in six times supercharging, compresses pressure rising from the power of original Merlin II. This two-stage supercharger has two rows drawn in a narrow duct, and exhaust liquid cooled intercooler mounted in induction system between second stage of supercharging and one of cylinder banks.



The British, hydraulically operated power-plant, gun turret, as driven by engine of General Motors, was a system developed concurrently with hydraulic system used for aircraft landing gear, flaps, etc. The "lower" of the unit is a three-stage pump giving pressures up to 1200 psi, with a flow of six gal per min. at normal engine speeds. This high pressure pumps coming down the axis of pump, through valve, then reducing and venting. Over all one of the turret is reduced by synchronizing movement of the gunner's seat with the pump. A "secondary" movement of the gun turret, which may be made independently, makes it possible to enlarge the field of fire to cover areas not reached by normal rotation.

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D-8  
Design—Materials  
Aircraft Tubing

## Aircraft Steel Tubing

Standard Sizes and Purchasing Instructions

THEY HAVE made a thorough study, for quite a period of time, of the various tube sizes which they have been asked to make. As a result of this study, it was found that the most

common sizes are listed in this table, including tubes up to and including 2" diameter. These should make every attempt to order aircraft tubing according to the table of standard sizes, attached.

Wall Thickness	TABLE OF STANDARD SIZES FOR AIRCRAFT TUBING																							
	Outside Diameter in Inches																							
	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4	6	6 1/4
ALLOY SEAMLESS AIRCRAFT TUBING (not standard)																								
102	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
103	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
104	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
105	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
106	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
107	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
108	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
109	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
110	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
111	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
112	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
113	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
114	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
115	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
116	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
117	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
118	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
119	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
120	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
121	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
122	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
123	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
124	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
125	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
126	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
127	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
128	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
129	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
130	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
131	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
132	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
133	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
134	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
135	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

### Aircraft Tubing Purchasing Instructions

In an effort to facilitate the placing of orders for steel tubing (welded and seamless) used in conjunction with the manufacture of aircraft and to help eliminate delays due to lack of sufficient information, the following should be carefully studied and the applicable data made a part of every order.

- Size must be indicated by only two dimensions (O.D. or I.D. and wall or O.D. and I.D.). Standard sizes of aircraft tubing should be ordered whenever possible. See attached lists of tubing industry standardized sizes.
- Gauge (steel analysis and temper).
- Specify machine lengths whenever possible. Also state finished part length. This may enable the mill to ship tubes which might otherwise be rejected because of length variation.
- Finish desired of finished part when tubes are to be machined on O.D. or I.D. or both. If drawing is not available, state finished dimensions after machining. In specifying the rough tube size, occasionally, descale treatment, and the sequence of machining operations must be considered.
- When tubes are to be defamed (heat) or otherwise specially treated, furnish the mill

with full information so that correct temper will be supplied.

- Specify government (A.N.) or AMS specifications whenever possible, and do not make "unqualified" references because they may be misleading. Where A.S. OR AMS specifications do not cover requirements adequately, tubing manufacturer's standards, as outlined in American Iron & Steel Institute's Steel Products Manual, Section 18, will apply.
- Following data are to be indicated and grouped together on every purchase order:  
Performance rating  
Control number  
Group classification (see general performance codes M-21).  
Identifying S.T. number (Revolving Unit Form 14).
- Statement that delivery agreement is not to relinquish of control requirements.
- Indicate direction and nature of material.
- Indicate whether or not government inspection is required and at which point this inspection will take place.
- Specify number of sections and test reports.
- On welded tubing, specify inside finish condition if this is not covered in the particular specifications to which the material is ordered.







# Review of Patents

By A. HARRY CROWELL,

*Registered Patent Lawyer*

**FLIGHTS** are drops of some of the most significant recent aviation or aviation developments granted by the U.S. Patent Office. Mr. Crowell will be glad to furnish readers information, without charge or obligation, on approximately one-half of the patents and patent procedures in applying for patents and trademark registrations. Address inquiries to him, care *AIRMAIL*, 333 W. 42nd St., New York. Printed copies of any of the patents listed below are obtainable at the each directly from U.S. Patent Office, Washington.

**Ground Speed Indicator.** Gyroscopic in structure, which functions independently of any movement on part of machine being measured by instrument's rotation, to give at all times an indication of speed of instrument's carrier relative to a fixed or relatively moving object.—2,503,195, T. G. Summers, Jr.

**Variable Pitch Propeller.** In this form of construction, an airfoil's throttle is opened wide at start of the run, and later, actuated by levered throat, made against pressure of a component wind. At same time, pilot may force blades that into chamber provided in forward end of hub. This shifts entire piston and back hole to left and additionally rotates blades to a minimum pitch angle reaching in an increased engine rpm. Pilot may be similar manner which a greater rate of shift. Throttle, first, may be actuated.—2,504,154, D. E. Davis, as agent to De Costa Aero Propeller Corp.

**Radial Bell for Antenna.** Improved, made and for wire antenna, particularly for aircraft. Ends is arranged so do coincide and form surrounding conditions to permit expansion of radial without danger of straining. Stationary in one position for rest in with radial and back back against, allowing portion stop for antenna in any degree of extension.—2,504,154, W. P. Lear, assignor to Lear Air, Inc.

**Control Mechanism for Combustion Flap and Airflow for Airplane.** An arrangement for combining the two mechanisms involved when, for instance, in landing pilot would want to increase lift of wings while plane speed is decreased, and when in making take-off pilot would want to use differential mechanism in order to operate one stream more than other.—2,504,941, J. R. Spencer, assignor to Blanton School of Aviation, Inc.

**System of Air Resistance.** An actuating system applicable to large or light landing position of aircraft, providing means for landing in air formation into unoccupied regions which may be made water by deployment of airfoil. Method utilizes heat and certain special structural members to divide air so current into only unoccupied regions.—2,504,986, H. Gugg, assignor to Heide, Aviation Corp.

**Fuel-and-Air Control for Internal Combustion Engines.** This invention, of particular application to aircraft engine, is designed to maintain proper ratio between mass of fuel and mass of air admitted to cylinders of engine despite variations in density of air in relation to mass of engine. It includes certain temperature and pressure devices which in operation maintain between them.—2,505,013, E. K. Miller and R. E. Dixon, assignors to Bristol Aeroplane Co.

**Mounting for Propeller Shafts.** Sliding into arrangement is used to support propeller shaft so that it may be swung in block of driving shaft and thereby supported in hull body or similar construction part. It is for use particularly when cylinders are mounted in an angle to each other.—2,505,024, E. Walther and A. Frensch, assigned to Allen Property Holdings.

**Aircraft Vibration Flight Testing for Determining Fatigue or Other Unfavorable Effect**

on structure is made possible by use of apparatus covered by this patent. It is stated that plane may be tested and its fatigue characteristics determined without actually producing dangerous fatigue. Various electrical measuring apparatus is included.—2,505,092, E. E. Minor and W. A. Kelpin, assignors to Glenn L. Martin Co.

**Heavy Wing Aircraft.** This relates to type of wing in which containing ribs is normally present does not involve any complete employment of means responsive to torque being transmitted to ribs. Ribbs in step or greatly reduce power of over load, thereby preventing or suppression of control driving torque. For example, power may be stopped by shortening ribbs between winging of supports or by closing sleeve.—2,505,583, C. G. Feltus, assignor to Douglas Co. of America.

**Apparatus for Landing Aircraft** includes an automatic radio control system for use with overlapping radio beams to enable blind landings. Receiver detects specific signals of radio beams, so that desired arrival path is obtained. Ultra high frequency directive radio beams of 10° angle per second are employed in apparatus.—2,505,624, W. T. Cooke and A. S. Harlan, assignors to Sperry Gyroscope Co.

**Propeller Mechanism** referred here has blades which are adjusted from a retracted position to full-thrust position. Mass of operating parts and forms constructed in use are distributed around periphery of blade to avoid excessive limited blade and unbalanced centrifugal force.—2,505,161, W. J. Blackwell and C. B. J. McNeill, assignors to The Western Aircraft Bank and Trust Co., as trustee. Another patent (2,505,162) granted to same location and assigned to same bank, covers a regulator for an hydraulic adjustable propeller. This, too, applies to extremely combined with mechanism which rotates with propeller, negating as final pressure movement in right or other stationary parts. A number of other blades under substantial centrifugal force does the controls application of hydraulic pressure to secure accurate setting of the blades and correct regulation of engine speeds.

**Landing Apparatus for Rocket Craft.** Device is applied to rocket blast shell. Landing mechanism operates from rocket and is left behind as rocketable speed is obtained. This rocket may be set off quickly and undesirable effects of slow acceleration are avoided. Cradle for speed movement is provided in a fixed frame and supports rocket shell.—2,505,125, S. H. Goldstein.

**Left: New type of plywood construction** is covered in plastic material. (See back) Strips of pine, ash, or other high tensile wood with grain running longitudinally, are glued to a film of latex (Fig. 1) or latex (Fig. 2) into a zigzag interposed (Fig. 3) into a zigzag surface (Fig. 4)—2,505,817, issued to Allen Property Holdings. (Page 2)



## Airplanes

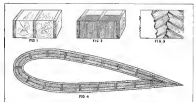
make "duds" of cardboard heroes

Every prophecy about the end of Hitler begins with a prediction of the fall of Mussolini. Italy's hollow shell may be the doorway to Europe. American planes, poised on the tip of Africa, look like the key to that doorway. One Koppers dream has been getting ready for that fateful day for years.

- building up the nation's greatest output of aircraft piston rings,
- making other companies the de facto art of making aircraft rings,
- helping a great aviation machine builder become a ring maker

Koppers American Hemispherical Piston Rings flow over Tokyo with Jimmy Doolittle. They powered the plane that rescued Eddie Rickenbacker, strapped to the wings, they took the pounding in PT boats that carried MacArthur out of Beten.

Other Koppers dreamers make ingredients for plywood planes and plastics, ties for support runways, electrode patch for aluminum, parts for planes and other products.—Koppers Company, Pittsburgh, Pa.





# 40 miles by taxi across the Pacific



One of this war's most dramatic stories started when a take-off accident damaged the wing of this Flying Fortress. Hours later, off course, hopelessly low and gas exhausted, its pilot landed it and the crew of seven on the open sea.



A Kingfisher Navy observation plane spotted the derelict—3 men aboard. With room for only one in the cockpit, the others were linked to the wings. The Pratt and Whitney Rapports (equipped with American Hammered Piston Rings) craned the overloaded plane across many miles of the Pacific to safety.



Packed into these little rubber "doughnuts" life rafts, they floated for 3 weeks catching rain for water, and a fish or two for food, battling sharks, storms, hunger and thirst with unbelievable fortitude. One raft made land. A PT boat picked up the second.



Workers in the foundry, the shop, the inspection department, all know that someone's life may depend upon each ring they make—which helps explain why every ring delivers that all-important last ounce of effort in time of need. Koppers Company, American Hammered Piston Ring Division, Baltimore, Md.



American Hammered  
Piston Rings

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THE INDUSTRY THAT SERVES ALL INDUSTRY

## Consolidated Subcontract System Coordinates Schedules

By HOWARD G. GOLEM  
Supervisor of Subcontracting, Consolidated Aircraft Corp.

New approach to work dispersal combats ever-present problems of manpower and material. Growth and possibilities of company-owned "feeder shop" operation explained.

SUBCONTRACTORS  
SECTION



Plane B-24 Liberator which, with state Consolidated plants C&E Johnson, Everts, PRT-5 Goshaw, and PRT-7 Corrado, will wing its 48 percent subcontracted. Components "leased out" include bombards and control systems.

ers, rollers, elevators, gun turrets, complete sets of wing panels, nose tips, elevators, flaps, landing wheels, landing doors, fuselage side panels, pinion casings, ball bearings, bolts, knobs, tables, galleys, equipment, and plastic physical parts.

Because of the ever increasing demand for aircraft by our armed forces, the vast problem of subcontracting was literally just beginning to arise. Most larger aircraft companies are enhancing the supply of manpower in the immediate vicinity of their plants and are utilizing all available plant space for present mass production. The only sources to turn are subcontracting and the use of feeder plants located in outlying districts, operated by the company. The feeder plant system is just beginning, and its full possibilities cannot at this time be evaluated. Steps which Consolidated has taken along this line will be discussed later in this article.

In view of the present expansion, the main problem is to disperse manpower, material, machinery, and tools from the main contractor's plant. Elimination of one department means more for its place of transfer within the plant.



Consolidated subcontractors are located in all parts of the United States. Personnel in Ryan Aeronautical Co., which is active in subcontracting, is also important prime contractor producing engines and control plants. Importance of subcontracting is emphasized by the use of Ryan's modern plant devoted and solely to manufacturing engine controls for leading United States aircraft.



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- ✓ Close A-Welders work easily with 40-70 Cometary Steel
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- ✓ Sixteen Workless hot bent wheels welding of great width in one pass and temperature control
- ✓ Annealing and Heat Treating Equipment
- ✓ All covering done by hot torching and hot workers
- ✓ Full complement of modern secondary metal methods
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  - (2) Band Saws
  - (3) Drills
  - (4) Brakes for Aluminum
  - (5) Brakes for Cometary Steel
  - (6) Milling Machine
- (7) Hand Saws for Special shapes
- (8) Hand Saws for curved pieces
- (9) Punch Presses
- (10) Abrasive Cut Off Saws
- (11) Drill Presses
- (12) Swaging Machine
- (13) Bench Grinders
- ✓ Complete equipment and skilled manpower to produce fine lightest and most exacting components

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Backed by 42 years' experience in fabricating sheet metal over two years' on special war products, our new Aircraft Division offers production facilities to aircraft manufacturers for increasing output of aluminum and steel parts and sub-assemblies.

This modern, completely equipped Aircraft Division is supervised by men specially trained in aircraft plants. Pro-

ducts now being manufactured include: Aluminum, Baffles, Elevators and Annular Bases in aluminum - Vertical Fins, Stabilizers, Elevators and Carburetor Intake Valves of Cromolloy-Steel. Other types of aircraft parts within the range of our organization are indicated by partial check list of facilities above.

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Sales and District Offices: Headed by Experienced Engineers in All Principal Cities



Ship in Lyons Plant

Continually growing production of small parts work to long needed low by business today. Lyons Co. workers, as in said in subject of expert specialists. Consolidated subcontracting setup makes complete production of both in- and out-plant schedules in finished aircraft can be delivered on time.

Consolidated work in subcontracting to over 100 major components made parts for the B-21D Liberator, the C-47 Liberator, the P-40, the P-51 Mustang, and the P-53 Corsair. These subcontractors are located all over the United States, which means that a fully completed aircraft has been set up in every instance of product and de-

## SUBCONTRACTORS SECTION

livery far enough in advance to keep the completed assembly lines in operation.

Practically all of the major components of the Liberator have been made in the company's plants up to the present time. However, the price of many parts, lack of available manpower in some California and Texas areas, and other factors make it necessary to be ready for more extensive subcontracting. Eventually, it is believed that about 40 percent of the airplanes mentioned above will be built by subcontractors. The present percentage is far below this, but subcontractors to subcontractors are increasing steadily.

Going back to the period between 1939 and 1940, it is found about 5 percent of the components of aircraft was subcontracted. An escalation occurred between 1936 and 1945 when brought on increase to 14 percent. The work has been doing ever since.

Contracted for as normally in work are the following parts of the Liberator: Horizontal and vertical stabilizers, (Link to page 312)



Order for a Consolidated's subcontracting system is extremely close coordination of production schedules on "finished" parts—such as tailings shown above being produced by John Smith Corp.—to keep assembly lines moving despite increased demands. Such coordination is one of the comparisons between subcontracting and home plant production.

## SAVE TIME

### HANDLING PARTS IN PROCESS



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• More than five years ago, a world famous flyer came into the ROMEC offices to tell us how proud he was of his ROMEC FUEL PUMP. This pump had been around the world twice on the same motor without even being dismantled.

With such a background of manufacturing experience, Romec was well prepared to play an important part in aviation progress. Progress that helps speed the day of victory.

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**Romec**

WE HAVE JUST ABOUT CONVINCED it was safe to say that the aviation industry was here to stay when the publishers rediscovered it.

Now we wonder. If this "Freedom of the Air" business turns out to be a really good, permanent political football, there's no telling where the men who build the planes and the men who operate them will get caught.

As the Haggard *News-Observer* said in the *Shoreland Airline Operator*, "It will be okay if they let it go with a few new 'globularists' and 'hot tail' contributions to the nation's vocabulary, but if there will appear 50-day 'vaguettes' inside in time soon, I'll give you half my pocket roll."

Get ready there for another guy who's been in the business 15 yrs. but still doesn't consider himself an expert?

• **Mazelet still happens.** Other day a man went into Washington's famed Postgate building, talked to those officers in those different places, and then got out—not only the same day, but the same evening! At 12:45 a. m. to be exact. He'd had several offers, but is writing to see if Congress raises the \$25,000-a-year salary limit to see if it's worth while.

• **Spitting of the Postgate—** who doesn't who's been to the Capitol—we thought those not control means you folks around there were in keep people from getting lost. But no, they're part of the rules; as we walked an employee's pass goes anywhere in the building without one.

We found out the hard way. Having learned to navigate from a particular office to an exit, we slowly started to play games for ya nicker and our publisher. No courtship, we lead in the house.

Still think it's because their faces aren't so open and honest as ours, but who's going to tell his boss that?

• **A rather widely known aeronautics "vaguettes" whose chief claim to fame was built on a back largely devoted to telling how busy the American Air Force was in one corner by an English newspaper as advertising that we carry all American fighter planes and build nothing but a single well known British type. Although that British type is now the fighter, the only guys we know about really like the author's idea are Miller, Hynes, and Marshall. Only thing they'd like better would be for us to use the author's slogan—day's never, as far as we can determine, get beyond the "first's" concept" stage in the pages of his book.**

• **The American pilot in the German West had everything on the day in**

the day—except something. He'd already been in a fight and had used it all that as the day headed right for him, finally, he decided he'd get me more out of the thing over by crashing head-on and going down too.

The day started to turn first—but not soon enough. His wing had just gone up when they hit. It was a terrible crash, and when the American looked back he saw the day wing that trying off in one direction, the rest of the ship and the pilot opening seaward. The leading edge of his own left wing was broken in, it had a lot of new fabric and ordered a complete back that German engineers never designed into it. But it was still on. And it stayed on while he flew back to his base.

"Of course," said the man who told us, "he had to land kind of fast and he ground looped."

He was dead at the open it he wants, wants. We're still got a good pilot, some spare parts and the knowledge that the guys and gals at Grumman are

## SIDE SLIPS

still having out plenty of slips which are just as rugged as the one that brought him home to his eyes.

• It certainly is true that spring's reaching a well known winter plane plant. One wing in the first month's area has been complained to his last man about the side. But they open the doors so often to show hand-painted planes, and that's how they know it's winter.



Maguire has his own ideas as how to fix the chaotic problem.





## Postwar Preview Of European Airways

By MAURICE A. GARBELL, D. Sc.  
Member, International Research Committee for Maritime Flight

**Feed for thought is the network of potential routes designed to speed rehabilitation of continent and ensure ultimate peace-time role.**

THROUGHOUGH the United States, planning is the "twenty-sixth hour of the day and on the eighth day of the week" has transcended the stage of discussion. Far from starting production dedicated to the immediate war effort, constructive thought projected into the future enters the stimulating phase which enables the man behind the map to the cockpit to start a steady first course while the war continues through heavy thunderstorms.

It is reasonable to conjecture that the present conflict will lead to a collapse of the Armistice in the European zone, which will initiate a period of reconstruction in Europe while the struggle in the Western Pacific enters its decisive phase. Japan, in spite of heavy shipping losses and other difficulties, will, we assume, have been able to organize and exploit at least part of the nation of her aggression. It will then be imperative for the United Nations to shift their military power with the greatest possible speed to the Pacific theater of the war.

The reconstruction of Europe must therefore be achieved rapidly and economically in order to eliminate a constant risk of further stress of energy through internal and external expansion on that Continent during such a critical period for the United Nations.

One training of a Europe corps of

governors, technical advisers, and political organizers to assist in an immediate reconstruction of the European continent does not come as a surprise to those who recall that after World War I, upon warfare ended throughout certain parts of Europe for at least two years (1918-1919) despite the all early concluded peace. Apart from the human considerations of the welfare of the hundreds of millions of homeless and suffering Europeans, the Continent must be reconstructed rapidly and efficiently to eliminate a menace to our Atlantic war and to give European industrial and agricultural production to our own war efforts as the Pacific.

Air transportation's role is such a program of reconstruction and reconstruction needs as discussed. Air transport has become a vital element in military and logistic operations. Besides,

• The routes outlined in the accompanying article are distinguishable from those of Dr. Garbell, who covered practically all of them during his years as a courier and as a member of the International Research Committee for Maritime Flight. Since coming to this country early in 1939 he has been affiliated with the Evans School of Administration and is now with Consolidated Aircraft Corp.

if not more important, is air transportation of essential military, technical, and political personnel.

With all due respect to our valiant Allies among the Continental Nations bands whom we are fighting on land, sea and beneath the sea, in the air, and "unhappily," we must anticipate a rather indifferent or perhaps hostile attitude of many Europeans toward an American-British-Hispanic effort to rebuild Europe. Our loss of economic colonies in Europe will have to be made in industry and able to function under any condition of local market, natural or man-made catastrophes, such as floods, forest fires, etc., and under the most adverse weather conditions.

This means, of course, that a system of European airways will have to be established and maintained. A speculative discussion of such a system is attempted in this article.

The present struggle of Europe, despite a few transatlantic and transoceanic lines, were primarily based upon short-range heavy transportation between important ones of the Continent. Meteorological conditions was good, but movement was limited by the non-existence of radio range stations and the inefficiency of airway traffic control which was, at best, spotty. Political difficulties added numerous other problems to the complexity of preventing air traffic in Europe.

The new European airways system will be essentially of global and transatlantic character, similar to that of the Americas. Europe's key position as a crossroads will be emphasized in the event of a prolonged Pacific conflict. Our accompanying map illustrates

(Turn to page 107)





# don't let faulty inspection cause you to scrap good parts . . . . .



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It has been repeatedly found that close tolerance parts rejected by fixed size gage inspection were quite often within limits when checked on a Visual Gage. In other cases, parts accepted by the fixed size gage are rejected by this more precise gaging instrument. The difference is the human factor—skill—experience—temperament—health.

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## Shifting Prospects For Airline Revenue and Profits

By **RAYMOND L. HOADLEY**  
Financial Editor, "Aviation"



**New light has been thrown on air carrier securities position by analysis of effect of excess profits tax—overlooked by many investors—possibility of fare reductions, mail pay cuts, and war contracts.**

WHAT investor and the investing public are generally here has so coincided with the future growth point of the domestic airline—and rightly so—that most investors have been paid to the revenue and savings outlook for the next year or so.

The short fact is that the general outlook in revenues will not consist of the increasing rate witnessed in 1942, and increasing tax burdens may cause a decline in profits from last year's peak.

This means that the investor who base airline shares at or near the highest 1942-43 levels is paying the premium usually demanded for the so-called "growth" stocks and he cannot count with any certainty on the continuation this year, and possibly in 1944 of the recent upward slant in revenues and earnings. Nor does it appear that premiums demanded on airline equities are just asked for the corner.

The airlines achieved unexpectedly good results in 1943, but some revenues are looked for this year in some important trade discounts. There are, however, no many "ifs" in the picture that there are not disposed to be dogmatic in carrying the outlook. Here is the way the situation stands up at present.

First, take revenues. The big gains registered after Pearl Harbor in passenger and express traffic have slowed up appreciably. And, since the government requested 65 percent of the airlines' "excess profits" last June, the gains in both of these revenue sources have been largely in the category of absorbing full passenger loads (today, load factors are as high as 96 percent at times, whereas 55 percent was not unusual immediately satisfactory before the war) and improved methods of loading freight. Then, too, the express demand may drop considerably in some instances due to changing war production conditions.

Second, construction and plant equipment, for example, will be naturally slowed in the war program moves out of the expansion stage by

the coming season. These will be less need to rush interiors, beds, and so on, as the war program will have war plants. Thus the spectacular upward curve in express shipments after Pearl Harbor appears to be flattening out.

At the same time it appears quite probable that passenger fares will be reduced in the near future, either voluntarily by the airlines themselves or through pressure by the Civil Aeronautics Board. The CAB has repeatedly stated, in recent and more definite, that the air carrier should give early consideration to passenger fare reduction. Thus there is the anomalous situation where a government agency is fighting for a cut in fares at a time when such a reduction would reduce some of the most valuable of the limited available seat capacity.

### Face Cuts Possible

Last year the airlines, as often, loaded passenger revenues by 9 or 10 percent by discounting discounts. What they are now likely to do now, as a result of the CAB pressure, is to make a reduction in fares by about that same. Such a reduction of and when it comes—will result, of course, in lower passenger revenues which is already being hit by the loss of new equipment.

Should the government suddenly decide to make available more transport as cargo planes for the wartime emergency operations out of the several thousand new air, the picture could change almost overnight. But while this is a possibility ruling some non-selective, trade discounts are not at all optimistic that it will be discussed over long in the immediate critical wartime shipping shortage and the present establishment of additional war plants in Europe within the next eight months.

The increase in mail volume goes on as a rather amazing pace and you will show a considerable gain this year over 1942. But here, too, there is an offsetting factor. The CAB has reduced

mail pay of most of the airlines. Reductions for the of the largest domestic air carriers aggregate more than \$6,000,000. This is in line with the government's policy of squeezing out the air mail subsidy as fast as the airlines demonstrate their ability to operate profitably without it.

Turning more directly to the revenue outlook, one finds that various taxes have been the primary drain, just as they did two years ago for most American airlines. For several years statisticians have taken pains to point out how favorably the airlines have been on the tax question. Unfortunately that is no longer true. For the first time many of them are meeting the excess profits tax head-on. The revenue side of recent years has been designed by Congress in not the airline's best interests. Their financial position is up to a critical point. But now that point has been reached and the airlines are finding the excess profits tax a shock to hit them with a vengeance.

This is the way it works out. The section of the 1942 Revenue Act dealing with the airlines (727-b) says in essence that airlines are exempt from the excess profits tax when they cannot adjust net income to zero or less. But the way of an airline adjusted net income cannot be less than the line's (1) excess tax credit based on invested capital, (2) net earn-over from the two preceding years of excess invested capital credits, and (3) the usual 50,000 specific exemption.

For example, an airline might have new-net income of \$700,000 and a total tax credit of \$1,200,000. Obviously, its adjusted net income here is zero or less, as is so with the exemption from excess profits even though its mail revenue might have been, say, \$100,000. That the airline in this case would have a total normal corporate and shareholder net income of \$500,000, which would be subject to the ordinary tax rate of 60 percent. Indeed, here, therefore, would amount to around \$300,000.

Now in after the above example a bit, assume that non-mail net income was \$1,100,000 with the same credit of \$1,200,000. The adjusted net income of \$100,000 which, of course, is more than zero. In this instance the airline would have an adjusted net in-



# MAKE THEM MORE AND MORE AUTOMATIC

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FIGHTING POWER \*\*\*

White-Rodgers automatic temperature modulation equipment relieves pilots for greater concentration on fighting power by providing completely automatic control of:

1. Engine cowling flaps (both air and liquid cooled).
2. Oil cooler shutters or flaps.
3. Cabin temperature (both vapor-charged and normal).
4. Carburetor air temperature.

Upon request, engineering data will be furnished to manufacturers requiring controls for the above or other temperature control applications.



War Birds—Scout Bankers  
Official Photo Courtesy U. S. Navy

## WHITE-RODGERS ELECTRIC COMPANY

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MISSOURI

case of \$5,100,000 less the \$1,000,000 credit—or \$5,200,000 which would be subject to the excess profits tax rate of 66 percent. Federal taxes would amount to around \$5,200,000. That means that on a gain of \$500,000 in one-half income, taxes have jumped—the \$5,200,000 is the example cited.

In other words, if annual pay is subtracted from adjusted net income and a profit of even 10 is left, then the airline is subject to the 66 percent tax on all income, including normal, instead of just the 50 percent tax. No wonder, then, that the CAB pointed out in recent mail-rate decisions that excess profits taxes would cut down airline earnings.

Part is that an airline necessarily can earn more profit for its stockholders if its non-aired operations are just at the break-even point than it can when a profit can be shown from non-aired services.

State comptroller at American Airlines, Russell, Eastern Air Lines, Transcontinental & Western Air, and United Air Lines are understood to be in, or closely approaching, the excess profits tax "zone".

A lot will depend on how the Bureau of Internal Revenue interprets the law now that this situation is coming up for the first time. And it is entirely possible that excess profits tax provisions, as they affect the airline, may be

changed in the pending 1947 revenue bill if Congress becomes convinced that airline hardships have resulted from the current law.

It should also be pointed out that the airlines do not have very large invested capital like some of the oil-stocks—the railroads, for example.

Even so, the airlines fearfully choose the intended capital exemption base rather than the alternative average earnings base, which is figured on average earnings for the years 1936 to 1938. While most industries had fairly stable earnings power in those years, the airlines generally operated in the red or close to it.

To temper the device, excess profits tax rules, there is a provision in the revenue laws granting a company to carry over its unused excess profits tax exemption for two years. Assuming that an airline company did not use all its exemption in 1941 or 1942, the credit presumably could be used as a tax offset this year. However, it has not been entirely clear how the Internal Revenue Bureau would interpret such points in the provision. Should annual pay, for instance, be deducted in determining

### AIR TRANSPORT

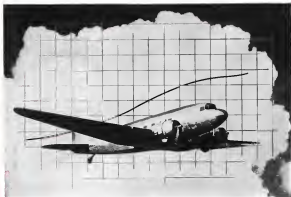
whether or not the credit has been used up?

In the realm of state taxation, too, a recent decision by the Supreme Court of Minnesota has given airline tax experts something to chew on. In that decision, Ramsey County, Minn., was permitted to tax the entire fleet of Northwest Airlines. The court's opinion stated that the state is free to tax the NWA fleet "as long as its part of it is permanently located in another state."

This is the first time that a company's entire fleet has been taxed by the state to which its headquarters are located. The decision leaves up the question whether in air, for instance, the first state over which planes that do not stop in a New York to Chicago en route, could properly levy taxes on the carrier's planes.

Here may be the opening wedge of state-imposed airline levies, so air

(Continued on page 405)









## TURNING THEM OUT *Faster*

**I**N MEETING the Government's goal of 10,000 planes a month, improved machining practices have been continuous.

A recent example is the machining of aluminum and magnesium alloys in engine plants, where an entirely new cutting coolant is permitting faster cutting speeds...Texaco ALMAG Cutting Oil.

Equally suitable for both aluminum and magnesium, Texaco ALMAG Cutting Oil adequately cools and lubricates the cutting tools, prolongs their life, increases cutting speeds, saves tool wear. ALMAG is transparent, permitting the operator to see...and is non-toxic to the skin.

So effective have Texaco Lubricants proved that they are definitely preferred in many other important fields, a few of which are listed below.

A Texaco Lubrication Engineer specializing in cutting coolant will gladly cooperate in the selection of the most suitable lubricants for your equipment. Just phone the nearest of more than 7500 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 E. 42nd St., New York, N. Y.

### THEY PREFER TEXACO

★ More lathemen and mill men in the U. S. are lubricated with Texaco than with any other brand.

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TUNE IN 1980 ALLEN EBBERTS SUNDAY NIGHT—CBS • HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



## TEXACO Cutting and Soluble Oils

### FOR FASTER MACHINING

• It is not only the excellence of an airplane which determines its effectiveness—for the best of craft, when grounded through shade or lack of knowledge, are of no use to anyone. The tremendous exposures achieved with the well known values of automobiles was due as much to the organization of supporting service chains as to the inherent value of the product. In this article, one of the first men to apply this philosophy to the aircraft industry makes clear the value and need of organized service by the manufacturers.

## MAINTENANCE

## Aircraft Service Organization The Gateway to Sound Operation



By ARTHUR L. FORNOFF

Director of Service, Bell Aircraft Corporation

### Solution: Service Man—

One whose work is servicing.

If you don't believe me, look it up in the latest dictionary you can find. But my advice is never to spring that one on an aircraft service man, particularly one who's been on foreign assignment where he has had to work on noisy 20-hp stretchers on his tired body one stand, after laboring without parts or tools to make the parts—without only on getting his company's aircraft back into the air.

First mechanical wizard, part diplomat, part war man, part top-notch design engineer, part writer of technical reports... all generous amounts of Yankee ingenuity and inventiveness,

and more with a balanced sense of humor, and you have—the Service Man.

But what I want to discuss is the organization which has to be established and shipped into smooth operation before any aircraft company can send trained service men out into the field and have the most good come from their efforts—the most good to the customer, Uncle Sam; the most good to the parent company, which has to draw heavily upon the knowledge of its service men in order to make next year's aircraft better.

It was recognition of this importance of a well organized service department to the continued efficient functioning of military aircraft which led to formation

of the Service Committee of the East Coast War Production Council, of which I have the honor to be present this morning. With this problem bearing large on our ground battles, only members of the Service Committee have in 1954 won a new perspective on the inherent long-range problem of service men trying to follow up their plans in the field without due recognition and authority. First, after their own experience in the military, again, using their plans.

Taking as an example the organization of Bell Aircraft, the service effort has more than justified itself. As shown in the accompanying chart (Fig. 1) it is a full department of the company, on a par with Engineering, Design, Production, and Control. The reason for this finding lies in the Service Division's intense usefulness through its compiled records of everything that





Fig. 1. In a six weeks course packed with study, these men are trained on ground equipment. Through groundwork here, longer more planes in the air outside.



has happened is the plane in the field. As contrasted to the experience in which function lies within the plane, the Service Division takes over the outside the plane because the history. Service both various, involved at Bell by standard methods established on experience, follow their work all over the country, as well as through 25 stations throughout the rest of the world.

It has taken a great deal of work to build the system in this period, but consider the value of the combined information which is always at hand. Every day and service men sends in his report—from wherever he is, be it from the farthest fighting front, and by whatever and how—covering all his company's planes in the locality. This information is broken down into a detailed analysis of every aspect to be considered. A national summary of this information at the home office makes always available a picture of the status of all equipment in the field, as well as an unbroken record of on which troubles may be analyzed and necessary adjustments.

The form reproduced in Fig. 2 is one of many breakdown summaries. Take, for example, an weekly report regularly properly changes at a possible loss. The calls for an inquiry as to the reason. We find the service men having to replace bearing noise with a new type. A recommendation flows immediately transferred to the production

Fig. 2. Form for weekly summary of reports issued in the weekly summary of reports. This goes at a glance in overall picture of maintenance work.

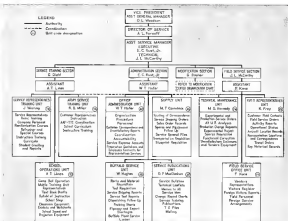


Fig. 3. Service organization chart. Bell Aircraft Corp.

line to build the proper new ones—whether this built at its source and seven weeks in time and parts shipped.

A large number of leading gear failures at any given instant calls for an immediate investigation by a specially trained technical assistance service representative. On arrival, he talks with the pilots to find out the conditions of operation, and watches their use of the equipment. He may find that some are bringing the ship in hard some more at 250 mph, others stalling in, slope down, at 90. In other words, using no proper standard procedure suitable to the equipment—and every model has its own particularities, requiring treatment designed especially to cope with them.

In a case of this sort lies the service man's main debate task. He will probably have to approach the matter with the pilot in another field, and we found a way to resolve it. Here's what we did—

(To be continued)



Fig. 4. On a packed up plane, all mechanics are studied and put on operation. Complete familiarity with every detail of four planes will make them more available when it comes to question, "How can we get our flying again?"



# Dynamic Balancing In Propeller Maintenance

By E. J. CUMNOCK, Senior Maintenance Engineer, Penn Airways

Diagram and plotting system provides means of achieving perfect dynamic balance as first attempt 95 percent of time. Eliminates guess work, saves time.

IT IS COMMONPLACE to assume all types of dynamic imbalance during engine overhaul. Such imbalance causes its magnitude due to manufacturing tolerances and different combinations of materials, design, mounting and load, and, assembles. Slight changes in mounting and even removal and re-

placement of propeller bolts can cause imbalance in dimensions and must be compensated to achieve smooth engine operation.

The propeller balancing diagram as Fig. 1 shows a systematic method of determining the number and location of lead dots to be added to the blades balancing both of propeller hubs.

A small metal indicator (Fig. 2) is attached to the top of the control nut. At the speed which causes the greatest amount of oscillation vibration in the hub, the extent can be read on the vibrometer. The latter indicates, from side to side, giving an ap-

parent effect of a "V," of which the point is the measure of imbalance. As rough area measure, this point of the "V" never deviates side, with changes given in results of inches.

Having determined that imbalance exists, it is necessary to find out where to place the lead dots for correct results. To distinguish both are propeller blades, each one is wrapped in turn with three sections of narrow adhesive tape at a point about 15 to 20 in. tip of blade, then causing an imbalance of lesser degree and location. Blades are run up separately and the reading for each particular blade is plotted on



the diagram in terms of inches. Readings for No. 1 blade are recorded on a scale vertically up blade, those for No. 2 along a vector parallel to No. 1 blade, and those for No. 3 along a vector parallel to No. 1 blade. A line is drawn from the end of the third vector through the center of propeller and is extended until it intersects the horizontal hub. To the nearest inch, or half, the correct amount of lead is added to balance propeller.

An exact and division of this weight is calculated according to the developed graph lines around center of hub. These were plotted by use of the formula for rotating bodies. Assuming an unbalanced force and measuring a definite relation between it and a balance bolt will produce their outlines, when introduced in the formula. When a plotted (Turn to page 600)

MAINTENANCE



Not even in the widest flights of fancy does the winged horse of mythology compare to the everyday miracles performed by the great flying horse of Pan American Airways.

But Pegasus had one advantage! He didn't have to fret over the problems of supplies, parts, repairs and the myriad details of maintenance that make Pan American's world-wide operations all the more remarkable in their amazing efficiency.

Valpar is quite proud of the fact that this far-flung aviation system was created. Valpar Val-Aero finishes it as its



bases in New York, Miami and Rio de Janeiro.

In its unsurpassed use of these fine finishes P. A. A. inspectors show Val-Aero stands up under severe service—delivers complete satisfaction in every respect.

What Valpar Val-Aero finishes do for P. A. A.—they can do for you.



A complete line of dependable Aircraft Finishes—that meet Government specifications • Valpar & Company, Inc., 11 East 36th St., New York, N. Y. • Est. 1932 Makers of the Famous Valpar Finishes





## TAKING TEST FLIGHTS ON THE GROUND



**The DENISON**  
ENGINEERING CO.  
2222 Duffin Rd., Columbus, Ohio



**DENISON**  
EQUIPMENT & APPLIED  
*Hydraulics*

The flight performance of many of the most vital functional parts of an airplane can now be accurately forecast—by tests made on the ground.

Hyd-Offer Test Stands are making these measurements, wherever tests possible—at aircraft plants, commercial depots and military air bases.

Three typical test stands are shown at left. One checks spark plugs for electrical leaks . . . another tests magnetos at almost any temperature, rapid, air pressure or humidity encountered in the skies . . . the third checks vital hydraulic systems to make sure that valves, switches, hoses, pump and doors, landing gear, and propeller controls will work correctly in the air.

Available in both one of many fields in which Denison Engineers have applied the exceptional consistency, flexibility and adaptability of hydraulic power. If you have a problem involving machine or precision products in production, our engineers may prove extremely helpful. Call your Denison representative, or write us.

## Britain's Ground Crews Batter Germany's War Plants

When the big bombers blast Nazi factories, credit the field men, the engineers, and the maintenance flyers. It's their work that makes possible the continuous pounding of Germany by heavy craft, such as the "Lancasters."

MAINTENANCE



PHOTO BY AP Wirephoto

Ground crew at work on an *Avro Lancaster*. This plane was developed from the *Avro Tutor* design, began its target bombing in service with the British.



PHOTO BY AP Wirephoto

Closeup of four of the four *Merlin* engines mounted in the fuselage of a *Lancaster*. This aircraft was first officially mentioned in the dispatch sent to the United States at Augsburg.

Even on your own ground, the *Lancaster*, Britain's newest and fastest large four-engine bomber, looks good and is good. It is not only fast, but also extremely maneuverable, in spite of its size and weight. Fully loaded it weighs 60,000 lb. Its span is 100 ft., length 64 ft., and it stands 24 ft. high. The test bench here can carry well over six tons of loads, which is less than the *Lancaster's* war load.

In combat, the *Lancaster* can give a good account of itself. This was again clearly proved by the effectiveness of many fighters in engaging *Lancaster* bombers. In fact, the RAF found by daylight in Malaya and La Crosse. Three large range daylight missions are without fighter escort. The trick of flying at night, however, learned from American crews, helps add to the defense.

### Eight Thousand Sounds a Minute

Newspaper, a *Lancaster* carries three power-operated turrets, which can bring guns to bear on any target within a wide range in a matter of split seconds. These turrets give the *Lancaster* a total armament of eight 0.50 cal. Brown-



PHOTO BY AP Wirephoto

Pecking and repair on one of the tail fin and some of the middle, will to one of these two widely spaced fins, giving excellent range for guns.

Airmen installing the four machine guns in tail turret.





# KNURLING OF

# UNBRAKO

## SOCKET SCREWS

*Gives You*  
**THESE EXCLUSIVE ADVANTAGES**



**KNURLED  
SOCKET HEAD  
CAP SCREW**

### KNURLING SAVES TIME AND LABOR

by permitting slipping, as the Engers can be used to fasten screws with speed and accuracy.

### KNURLING PERMITS LOCKING

After assembling, a few quick blows with a spirit-hammer, forcing a shiner edge and point to corner, displaces enough metal to engorge knurl and lock screw. Screws can be locked and used over and over.



Spirit Hammer  
to lock and  
locking tool.



"UNBRAKO"  
HOLLOW CUP PLATE  
of Steel, Dimples 3/16" and  
3/8" diam., 1/2" to 1"  
dia.

**SELF-LOCKING  
HOLLOW  
SET SCREW  
with the Knurled  
Point**



For 1/2 and  
3/4 inch  
Threads



**Knurled Point Lock Screw**

The knurling is so closely done that—as the principle of a ratchet—the point makes no resistance when screw is tightened, but as soon as vibration tries to loosen it, the knurl "dig in" and positively prevent it. Screws can be removed with a wrench and used repeatedly.

## Plus THESE ADVANTAGES

**UNBREAKABLE STRENGTH**—"UNBRAKO" Screws register an ultimate tensile strength of 117,000 lbs. per sq. inch. **METAL SAVING**—The great strength of "UNBRAKO" Screws permits the use of smaller and fewer screws. Because the key operates within the socket "UNBRAKO" Screws can be used in the closest of spaces or designs can be more compact and lighter. **WITHOUT SAVING**—The HEX SOCKET, mechanically indispensable, also helps to save weight—metal is directly design. **CLOSE TOLERANCE**—"UNBRAKO" Screws are precision made. **DELIVERED**—before this example. **SIZES**—from No. 4 to 7/8" diameter.



HOLLOW SET SCREWS  
1/2" to 7/8"  
A knurled hex set screw  
with UNBRAKO  
point.

*The strength of Unbrako Screws, substantiated with "Unbrako" tests, are:*

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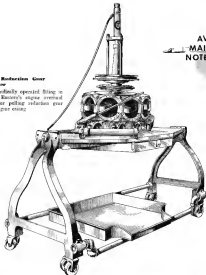
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AVIATION'S  
MAINTENANCE  
NOTEBOOK

### EAL's Reinforcement Gear

**Reinforcement**

Hydraulically operated fitting is used at EAL's engine overhaul shops for pulling relation gear lines under strain.



### Cranehaft Alignment Jig in American Shops

Cranehafts, beams are standard, but the special installation design was worked out by Elmer Boggs, Jr., of American Airframe. Monometer gauge, which gives readings to .0005 in., is attached to a beam which swings away from checking position to allow installation of cranehaft. Height adjustment is afforded by threaded collar on beam. Clamps at right, with a similar one opposite, holds shaft for checking master and bearings. All beams are fastened to a heavy steel bed for permanent concrete position.







## VICTORY'S MARGIN MAY BE FEMININE

Long since have we given up the idea that men alone can both fight and supply a global war. Clearly is this viable at Solar. Increasing numbers of women workers are assuming increasing importance

in the production of "anti-monoxide" exhaust systems for the fighters, bombers and cargo airplanes of the United Nations. Well may it be said that on the production line, Victory's margin may be feminine.

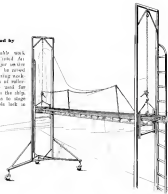
**SOLAR**

EXHAUST SYSTEMS—

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### Elevator Work Stood by Fitted

• All purpose adjustable work stand developed by United Air Lines and used at major aviation stations. Standfield can be moved in forward, without having work any position by means of roller chain hoist. Can be used for nearly any position on the ship. Loads movable across the stage at any height. Whole unit is portable.



AVIATION'S  
MAINTENANCE  
ROSEBUD

### Hydraulic Test Stand of American Airtheon

• In testing all hydraulic assemblies and valves which can be mounted from the shop, this American-designed test apparatus a variable speed electric pressure pump of non-driven piston type which gives up to 2,000 psi. Assemblies requiring higher pressures can be attached to one of six outlets at right and be tested to 12,000 psi. Stand, which can be used in racks, or at left, pumped up to required pressure and the lines shut off, leaving test units pressure for any length of time, without relief and dead gear readings. For shock on relief and rate of leakage. On opposite side of stand is a similar rack for electric pressure Division in operation of releasing, and other gear. With two lines for measuring at both ends of unit to be tested, pressure can be run in and out, pressure readings giving guidance in action. The little cross in lighting of packing, too much (more than 15 lb.) will be leaking. Operator is holding a bar not valve.







## Norway's unconquerable warbirds

These are the deadly Northrop M3 Patrol Bombers with which the Royal Norwegian Naval Air Force for nearly two years has helped to hold the Nazis on our North Atlantic sea border.

By mid-June 1940, the Nazis had overrun all of Norway. And we here at Northrop had just begun work on a new patrol bomber for the Royal Norwegian Naval Air Force.

Quit? Not those fighting-hearted Norse! Teaming up with the RAF, they established "Little Norway" in Canada, ordered as to rush completion of these Norfrap N3-PB's for combat use in the Far North.

The job, from preliminary sketches to the first hammer off the fire, took us exactly nine months and one day.

We're particularly proud of that record, for the N3-PB is a favorite with Northrup men and women. Not just because this head-biting machine is the

because she can pack 2000 pounds of bombs or a torpedo with equal grace. Nor is it because she can throw more lead than many a four-masted barge. What pleases us more than any of these virtues is her *STURDYNESS*.

Battered for nearly two long years by North Atlantic winds and waves and storms, with vast distances their everyday assignment, these swift patches of Norway's Royal Navy have proved a

much as the Valiant's story who fly down.

In battle, the Northrop N3 Patrol Bombers have shown their strength, too. They have sent to the bottom more than their share of U-boats. They are reputed to have taken part in the epic chase of the Bismarck. They have driven back about German bombers.

We hope you'll pardon a manufacturer's pride in relating all this to you. For the Northrop NS-30 is just one of a number of American-built airplanes that have helped to set the pattern for victory. (You can help to shape this victory pattern more fully by buying this Northrop in increasing numbers.)



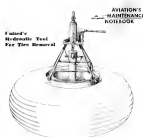
**NORTHROP AIRCRAFT, Inc.**

本報告書は、2014年10月1日現在の状況に基づき作成されたものであり、今後の状況の変化により、本報告書の記載内容と異なる結果が生ずる可能性があります。



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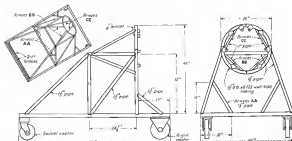
• Simplified novel fixture enables endowing workman to keep workpiece of artificial horizon fully under control at all times. This is very necessary, while horizon is being used for the purpose of checking bar setting times from the different displacements which are necessary. TWA personnel report that unit to be one of the most used fixtures in the overhead shop.



United's  
Hydraulic Tool  
For Tree Removal

• **Steel frame and hydraulic jack**, which fits over axle and is secured by pins through hole hole. Pressure applied by jack forces the frame down, separating tire from fender without damage to either. Developed from suggestion offered by Bill Pitt, United Air Lines mechanic, and in standard service in United system.

## Chicago &amp; Southern's Portable Engine Test Stand for Continental Engines



\* Detailed drawings of portable engine test stand, designed by W. L. Anderson, Superintendent of Engineering at Chicago & Northern. This is the stand pictured in article titled, "Adapting Assembly Line Technique to Engine Overhaul," page E28, Dec. Aviation. Overhauled engines are bolted directly to stand and checked in test cell, where they

are looked in place for run in, setting time and handling. Location of mounting holes will be found in Component Operating and Maintenance Manual of Model W570, series 6A & M4, p. 41, Fig. 15. Perspective drawing is not to scale, drawn merely to show position and inter-relationship of beams not visible in dimensional details.





As a long-time user of Butler Built steel larger machine shops, machine and truck test, relating with the aviation industry is notified to know why we are unable to fill orders—except on high priority orders.

The explanation is in the complex picture above. It shows Butler Built steel products that are going to be some of the most vital equipment of modern warfare.

With steel shortages are felt, until steel shortages, thousands machine shops and warplanes are needed, until refueling tanks are on the battle fronts, are warplanes and mechanical fighting forces cannot begin to have their mechanical forces and tanks. In it is that Butler Built steel warplanes and around the clock to match the needs of the aircraft and mechanical equipment.

As Butler produces for war, Butler engineers plan for peace. Butler Built steel buildings for the aviation industry and war have already emerged. Welcome the Butler Built frame structure pictured at the right. There the clear head room is the very part of the goods.

**BUTLER MANUFACTURING COMPANY**  
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**BUTLER BUILT**  
 STEEL BUILDINGS

FOR SALE—SHARES IN TOMORROW—U. S. WAR SAVINGS BONDS



# AVIATION'S MAINTENANCE NOTEBOOK

## Chicago & Southern Engineer Plan Test Bench

For installation and the testing of Bendix Revolving injection carburetors, the next is standard except for addition of small Parker & Davis flow meter for testing air adjustment setting. By setting of balance engine to an established standard for setting, then, adjusting air flow to an established standard, it has been found possible to adjust the carburetor of carburetor prior to installation on engine, with very little trimming adjustment required on engine test. Another addition is a large Parker & Davis flow meter as a double check against standard Bendix flow readings normally taken on the stand.

## PAC's Propeller Bolt-and-Nut Wrench Attachment

To maintain "helping out" tendency of horizontal gripping action of propeller retaining nut wrench, William Johnston, Chief of Propeller Shop at V. propeller shop has devised this ring which fits tightly over round "nut" section and made ready inside forward, hand shift. It consists of two rings, the inner working freely within the outer on roller bearings, takes from an old thrust bearing. Inner part turns with wheel, gives free rotating support, prevents slipping.



## TWA Bench Oscillator

This pocket-sized oscillator was designed to perform the large battery feeding work for the maintenance job of function testing Gyroscopic Control Units. It consists primarily of a mechanism which gives instruments about all three axes of motion in a gentle synchronous movement adjustable in three steps from 6 to 30 deg. of amplitude. Use of this oscillator during offsetting results in better accuracy per movement of directional gyro and Artificial Horizon leads system. Power and results of motor driven gear reduction has connected under offsetting bench to conserve working space. Oscillator, when stopped in either right or left hand position, can be used for tilt test offsetting in angles of 4, 7, and 15 deg.







**"THUNDERBOLTS"...** Across the field and out of sight in a matter of seconds, Republic P-47 squadrons, in thunderous flight, streak to battle. Such speed and power mark a new epoch in high-altitude fighter combat... portend the final purge from the skies of the emblems of piracy.

# REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION



MANHATTAN, L. I., NEW YORK



**Fig. 1.** The 1930 forerunner of the modern aircraft gun turret. Although not power operated, it was considerable sized, and the power was transmission of the speeds of that day, and relative to the greatly advanced loads which could be obtained with the standard design—was required to train his weapon efficiently.

## MILITARY



**Fig. 2.** Second step in gun turret development. In 1925, gun turret a great deal smaller, but still electrically driven. Here, power turned with its gear, had all means of rotating through the same stress point.

## Designing Gun Turrets As Integral Part of Aircraft

By L. G. PRISE,

Chief Engineer in Aircraft and Armament Division, United States Army.

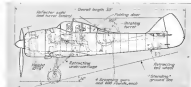
Development from hand-operated to hydraulic-powered multi-gun units is traced by sketches and photographs which reveal designs and construction details of British turrets.

ON THE 19TH MARCH held today by Royal power-operated gun turrets is due largely to the fact that these units have from the first, been designed by the men who created the aircraft in which they have been proved. The history of this method—over the other

side of trying to standardize a turret without control over the design of the aircraft to receive it—has to be experienced to be appreciated.

The many military aircraft types developed by the British Co., have enabled consideration of practically all forms

of offensive and defensive armament. Thus it is perhaps more convenient to date our description of the modern power-operated multi-gun turret from the first attempt, back in 1906, to enclose the gunner and gun, thus removing him from the stream.



**Fig. 3.** First remotely controlled gun turret when gunner did not occupy the turret proper—a hand-operated gun both side a two plane fighter.

















## Maker of Air History— The Boeing Flying Fortress

ANOTHER PLACE  
WHERE BELDEN WIRE GOES TO WAR

A familiar figure on battle fronts from the Bering Sea to the Mediterranean or the South Pacific, the Boeing Flying Fortress has provided a perfect platform for wonderfully accurate, high altitude precision bombing. Since Pearl Harbor, the famous B-17 has constantly made the "news" with amazing feats of stamina and prowess.

With production more than quadrupled—and an ever increasing demand for more—Boeing Aircraft Company has maintained in all detail its high standards for workmanship and materials. And, here along with thousands of other service tested parts, Belden wire goes to war.

Back of Belden success wire is a lifetime of experimenting and working—collaborating with aircraft engineers over flying wire in its history. This vast experience makes possible the Belden wire that meets today's needs.

Belden Manufacturing Co., 4625 W. Van Buren St., Chicago, Ill.



Assembling a harness for the B-17 is the Belden plant. Belden wire is used.



Approximately five miles of wire are used in a Flying Fortress. Every connection is inspected by experienced craftsmen.



Awarded the U. S. Treasury Special Certificate of Merit for Superior Wire Used in Civilian Aircraft.

# Belden Aircraft WIRE

Starter, Lighting, and Instrument Cables • • • SPARK PLUG WIRES

## Messerschmitt Me-210A-1

Latest Nazi fighter-bomber features remote-controlled "blister" guns for rearward protection, also new type dive brakes.

EVIDENCE that Germany's Luftwaffe is attempting to catch up with the United Nations in the field of power-operated gun tactics is given in reports on the Messerschmitt Me-210A-1, long range fighter-bomber.

Designed from the Me-110, the new craft carries a mix of two, a pilot-bombarder and a radio operator-bombarder, and it is designed for use as a long range fighter, close bomber or ground attack craft. Delivers almost 1,000 lb. of bombs with a total weight of approximately 900 lb. is provided for both crew and vital parts of the plane. Armament consists of two 20-mm. Mauser cannons and two 7.9-mm. machine guns, fixed in the nose, and two 13-mm. machine guns firing in the rear in remote-controlled "blister" guns.

This latter installation is perhaps the most interesting on the plane. The rear gunner, facing backwards, is seated just behind the pilot under the most complete cover, close and ahead of the guns. Aiming through reflex sight, he controls the guns through a pliable control strip.

Both guns are mounted in streamlined housing in the end of a drum which runs through the fuselage from aft of the leading edge of the wing. Movement of the pistol-grip engages friction bands with either of two small drums—revolving in opposite directions from power delivered by a 14-hp. electric motor—to rotate or depress the guns. Movement of the small drums is transmitted through a gear train engaging a gear which actuates the gun drum.

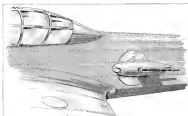
A maximum swing of 75 deg. can be accomplished, 35 deg. above horizontal.

### Specifications and Performance Data

Wingspan	45 ft. 3 in.
Length	37 ft. 6 in.
Height	14 ft. 6 in.
Wing loading	11.5 lb./sq. ft.
Max. load	10,000 lb.
Max. speed	300 mph
Max. altitude	30,000 ft.
Max. range	1,000 miles
Armament	Two 20-mm. Mauser cannons and two 7.9-mm. machine guns, fixed in nose. Two 13-mm. machine guns in remote-controlled blister.



Among latest German planes is Messerschmitt Me-210A-1, long range fighter bomber designed from last year's Me-110. Forward-looking in late design it is built up with United Nations fighters in use of power-operated gun tactics, details of which are shown in accompanying sketch.



Remotely controlled by radio operator-rear gunner, who sits just behind pilot facing to rear, are guns on each side of fuselage at rear streamlined blister. Motors in electrically-rotated drum running through fuselage to give maximum of 75-deg. elevation and nose depression for 13-mm. machine gun. Lateral motion, also limited to 35 deg. to the side, is given by similar unit operating with drum.

and 35 below. Lateral movement of the guns is given by a similar friction band unit, except that in this case a gear surrounding the drum is attached to a gear which, in turn, drives a piston to

impart the motion. The guns can be retracted but 3 deg. off center, but they can be swung independently, however, to a maximum of 35 deg. toward the side.





## BANISH GHOSTS WITH THIS NEW TRACING CLOTH

PHOENIX is the new kind of tracing cloth, proofed against perspiration stains and water marks — that fade's tracing paper at a moment's notice. PHOENIX gives you clean tracings, in pencil or ink, free from pesky "ghosts" that reproduce on blueprints!

An exclusive new process is responsible for this amazing performance, a process which defies moisture, and gives PHOENIX its unusually durable working surface. You use harder pencils... get sharper lines with less ten-

dency to smudge. Even GEL pencil lines show clearly, and separate strongly. You don't smear the surface when you erase; erased areas take pencil smoothly — and ink without feathering. Its new white color and its increased transparency provide excellent drawing contrast... produce sharp tracings. Give PHOENIX your own drawing board test. See your K&E dealer, or write for a free sample working sample and as illustrated brochure.

### PHOENIX BUILDS MISTERY GHOSTS

Perspiration and water stains on ordinary tracing cloth ruin those which reproduce on blueprints. PHOENIX Tracing Cloth waterproofs and proofed to give a new kind of tracing cloth. It is made for daily use in offices, at home, and in the field.

### PHOENIX BUILDS SHADES GHOSTS

The new waterproofing of PHOENIX Tracing Cloth prevents even the most severe rain and the sun's rays from fading your tracings. It is made for daily use in offices, at home, and in the field.

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PHOENIX is a new kind of tracing cloth, proofed against perspiration stains and water marks — that fade's tracing paper at a moment's notice. PHOENIX gives you clean tracings, in pencil or ink, free from pesky "ghosts" that reproduce on blueprints!

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As is the case in the Me 109, the food machine gun and cannon mounted in the nose are equipped with flash tubes (see page 30, *THE AVIATOR*), which cut on firing.

A new "variable" in dive bracket for both upper and lower wing surfaces, has been developed on this new Messerschmitt product. Mounted just behind the single spar, the bracket control of independently operated parallel profile-canted 10-degree aluminum alloy slats, the brake for the top surface has two three-cash slats, the lower, four. In retracted position, the bracket fits flush with the wing surface to eliminate drag for normal flight.

The Me 109-A is equipped with two Mercedes-Benz 100-800 H.P. engines. These appear to differ from the 100-800 H.P. used in the Me 109B fighter only through addition of special ducts which direct a stream of cool air to the spark plug valve and exhaust stacks, the latter probably being an attempt at flame damping.

The plane follows conventional construction practices, the wings having metal upper, ribs and flush-mounted metal covering, and fabric-covered aluminum. The wing structure is both metal, but rollers and elevators are fabric-covered.



### SIKORSKY HELICOPTER PASSES ARMY TESTS

Army-Sikorsky helicopter which, following Wright Field tests, resulted in award of production order to Vought-Sikorsky division of United Aircraft Corp. Ground model is of welded tubular construction. Main rotor has diameter of approximately 36 ft., vertical mast at tip is 17 ft. Ground length of craft is approximately 26 ft., height 12 ft., and gross weight 3,400 lb. Power is furnished by T-12 engine by gear and shaft transmission to the two rotors. Craft can be equipped with low pressure tires in separate low land, water, snow, mud, or dry air.

### Bird-Proof Windshield

Protection of pilots against injury or even death resulting from collisions with flying birds, together with satisfactory design, appears successful following recent comparative experiments. Numerous injuries have resulted from shocks, wild gusts, updrafts and other birds striking through windshields, especially at night. In an latest test, a bird went through the windshield, the backboard, on through the length of the cabin, and on into the baggage compartment.

The results to date has produced a plastic and glass shield which will withstand the impact of a 15 lb. bird traveling at speeds above 300 mph. The experiments were directed by John H. Smith, chief of the Civil Aeronautics Administration's Technical Development Division, and A. L. Meyer, chief of the Aircraft Development Section of that

Division. Co-developing were technicians of Westinghouse Electric & Mfg. Co.



### FOR SAFER FLIGHT

Compassionate gun shoots freely-filled birds against windshield, under simulated flight conditions in comparative government industry research program to eliminate injuries due to collisions between planes and birds in flight. Plastic and glass windshields, working with CAA, have developed windshield which will withstand impact of 15 lb. bird at speeds over 300 mph.

### FLYING EQUIPMENT

E. I. du Pont de Nemours, Monrovia Chemical Co., Pittsburgh (Pittsburgh Glass Co., and E. I. du Pont de Nemours Chemical Co.) Washington developed a special compressed air gun with an 8-in. bore and 20-in. barrel into which freely-filled birds are placed, and the four nozzles, and shot against test windshields at speeds reaching actual flight conditions. Velocities in excess of 400 mph can be achieved.

One promising type of panel developed is made by laminating a 4-in. sheet of specially prepared polyvinyl acetate resin between two pieces of non-tempered glass, each 1-in. thick. The amount of plasticizer used is adjusted to provide maximum toughness and resistance to fluid permeation. The 4-in. plastic sheet is cut to size on each beyond the glass and is held in the reinforced metal frame of the aircraft. To prevent the windshield tearing loose from the frame, sheet metal strips are embedded in these reinforced edges.

The complete windshield assembly includes a front pane of 1-in. tempered glass, separated from the impact resistant panel by a narrow air space through which hot air can be circulated to serve as a de-icer.

### Eyes To Build New Navy Combat Plane

Eyes Aeronautical Co. is recent in production progress to take on design of a new combat craft for the Navy. T. Claude Ryan, president, has announced.



# WARHAWK Production

## Cleveland Courier Service Gets Industry Backing

### CIVIL OPERATION AND TRAINING

#### Women Instructors Graduated

First lot of what the state hopes will be leaders of women flight leaders have been graduated from the Women's Instrument Training School stationed at Nashville in the Tennessee Bureau of Aeronautics.

So great was the demand for their services since 13 weeks' training under the direction of Elmer O'Brien, an aviator from C.A.A., that the state is urging the Senate Appropriations Committee to provide \$2,500,000 for the production of 500 more women aviators in other parts of the country during the next six months, with 400 others in training. Tennessee alone has received 3,000 requests for such instruction.

Each of the new leaders offered approximately 120 hr. flying experience when accepted for the course. One was a postmaster's assistant engineer, another the wife of a C.A.A. instructor and a member of C.A.P. During training these women taught their peers in the air up to a maximum of 100, qualified for a commercial pilot's certificate, the rating of flight instructor, and additional ratings for completing sections in meteorology, navigation, aircraft structure, engine, and civil air regulations.

Before their services were needed from school boards and flight instruction institutions throughout the South. One Florida instructor offered jobs in the whole state. At present, however, the graduates are scattered from New Mexico to Missouri.

Funds for conducting the flight instructor course were derived from the Tennessee state aviation fund. Of the seven cents collected on every gallon, half is retained by the selling airport and the remainder forwarded to the Bureau of Aeronautics. This money has thus helped under airports and enabled the Bureau to install state-wide air markers, conduct civilian education projects in every county, print tool-books, and give a course in airport management at the University of Tennessee. Present income of \$500,000 a year is being spent on further airport work in flying facilities and instruction.



over 3,000 hr. experience in air, are saving materials and personnel from Cleveland war plane in place of broken air tanks.



One urgent request came from Peter Kory Carr, whom A. E. Jorgensen (left) director of the national department, found that 50 Army field Kory machines were being held up by lack of action. James Dean, company purchasing agent (right), showed details of difficulty in Center Service after provided by Cleveland Chamber of Commerce.



A plane was dispatched to Moffett, Okla., and brought needed action back to Cleveland where a Police was sped back to Germany. Two days were spent, and Kory machines made away Nashville, Miss. Duxbury Turley, whom 1942's flying experience of 120 hr. was then given nearly with CAP, kept Curtis-Wright production line moving by flying 50 hr. of parts into Buffalo center station, now wanted by 30 pilots and 12 planes.

ATLANTIC, April, 1942



John — Curtis Wright machine making both engines and in line A.P.C. 10 Ingersoll-Rand center



John — Ingersoll-Rand 10000 shaft with single compression pump turbine turbines.



John — Ingersoll-Rand 10000 shaft with single compression pump turbine turbines.



OTHER IR PRODUCTS: ROSE DE PLANT, COMPRESSION, STEAM-DRILL & GAS ENGINE, SOL PNEUMATIC TOOLS

## AIDED BY COMPRESSED AIR POWER



100 hp of Ingersoll-Rand steam and diesel-driven compressors in a Curtis-Wright plant.

Curtis-Wright is producing a steady stream of those swift and maneuverable P-40 Warhawk fighter planes that deal deadly blows to the enemy.

Compressed air plays an essential part in the production of these planes. Its use is essential in the areas that produce aluminum, copper, iron, zinc, tin, lead, magnesium, and other vital metals. No forge shop, machine shop, or fabricating and assembly line could get along without it. At the flying fields compressed air inflates the tires, charges the landing-gear shock struts, and helps in many ways to keep the planes ready for action.

Tools operated by compressed air are light in weight, easily handled, quickly adapted to many kinds of work, extremely durable, and economical to operate and maintain. Many jobs cannot be done as well, or even at all, with any other form of power. The building of compressed air machinery—all kinds of compressors and the tools that use the air—has long been Ingersoll-Rand's job in war and peacetime.

Ingersoll-Rand  
11 Broadway • New York, N.Y.



Illustration of the Ingersoll-Rand 10000 shaft with single compression pump turbine turbines.





PLEDGED to all-out aid to America's fighting forces, NORMA-HOFFMANN is devoting all its resources and its 32 years' experience, to the production of PRECISION BEARINGS for the Army, Navy and Air Corps, and for manufacturers of armament and equipment.

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**BALL, ROLLER AND THRUST BEARINGS • FOUNDED 1911**

son of aircraft engines is school curricula.

"This Bureau has successfully presented in the sort of program which can best be done by a state government," says CAA. "The interest in flying which will result from the expanded CAA training program is likely to increase the success and make possible still more provision projects throughout the state."

## Along the Apron

"The CAA War Training Bureau (formerly known as the Civilian Pilot Training Program) will continue," announces E. McKee Stuart, the administration's executive director of training. "The manner that it will be taken over by the military has no fatal foundation. The stress is, and will continue to be, the continuing agency through which flight instruction continues will deal in respect to all matters having to do with the conduct of pilot training programs for the Army and Navy."

Amendments to CAA regulations now provide ratings for aircraft mechanics, aircraft engine mechanics, and factory mechanics. Candidates who have filled examinations for mechanic certificates may apply for certification after 30 days. Those who finished only the test

son of aircraft engines is school curricula. as Civil Air Regulations and also present evidence that they have taken the additional hours instruction in this subject.

Statutory limitations in group 25 members of Boeing Aircraft Co. advised training in spare engine and related subjects necessary for the building of the large physical wings planes suggested by Shipbuilder Henry Kaiser.

In a suggestion for the War Department Commission, Mr. Dudley H. Ladd, 335 E. St. No. 8, Washington and Jefferson College, Washington, Pa., tells the present labor training program "highly satisfactory" but "inefficient" and asks for a "well planned, continuous program of aviation picture training" in which this could be exchanged between appropriate services and industries.

Scholarships in ground training subjects—navigation, engines, radio—for 30 public school teachers have been offered respectively by New York University and Polytechnic Institute of Brooklyn. Applicants must certify their selection to teach secondary school aviation subjects during the next academic year.

First exams were offered to women by Lincoln School of Art Training, Cleveland, has been completed by 13 candidates.

Downloading of two new fields at the Pennsylvania Naval Air Training Center virtually completes the expansion

## CIVIL OPERATION AND TRAINING

work commenced there November.

Major James H. Dunlap has received the Civil Aviation Training Award's annual award for high accomplishments in service state.

## On Patrol

A bulletin, *Photo about CAP Training*, is being distributed among the Wings by CCB.

Applications for repair jobs are now being handled by GPO support offices, which have been authorized to accept priority ratings up to and including A-1 on requests related to and over \$500.

A revised edition of Civil Aeronautics Manual No. 10, *Air Traffic Rules*, is available from the Superintendent of Documents, Government Printing Office, Washington, for \$10.

First distress case to receive the War Dept. Air Medal, CAP members Maj. Hugh B. Sharp, Jr. of Washington and Lt. Edward J. Edwards of Miami, Fla. (see a rural aerial), have been decorated by Pres. Roosevelt for performing a rescue at sea. When a plane on coastal patrol was forced down, killing the observer, Lt. Edgar Shelton of Columbia, South Carolina, as Army service, Sharp and Edwards landed a Sikorsky amphibian in rough water and pulled the ailing victim, Lt. Henry T. Goss, aboard. The landing damaged the left wing hook. To balance the weight in a tailwind rode on the right wing (2) the plane landed within range of a Coast Guard boat.

Progressive use also greatly increases vigilance, judging from the experience of some Florida boys. In technical planes they averaged over 4,000 acres one recent cold night and kept the airfield in front would not form.

According to figures in a recent report made on the House of Representatives by Harry W. Stearns of Yonkers, the New York Wing is the largest in the corps, with 4,000 members in 6 groups and 25 squadrons. Ohio comes next behind with 4,212 members.

Safety Bulletin No. 216, *Cockpit and Instrument Flying*, has just been received by CAP.

Carrying out the CAP's program of flying and to reduce needed Army pilots, Mrs. Dorothy Hamilton is carrying the route between Rome and Portland, Me.



**Instructor's first lecture—Orville Low, supervisor of American Export Airlines' first overseas route in company with the Navy and Army, and others at home and foreign stations, explains the points just before graduation of class. Seated (left to right): Elmer Gough, Elmer Low, and Walter Blackman. Standing: George Wright, Peter's Landing, Peter's Landing, and Dorothy Arnold.**







# BULLARDS are Way Up There



## ONLY V.T.L. HAVE

Vertical Lathes  
with turret  
lathe tool holder  
and  
special fixture

America is now rapidly overhauling the Axis in the air. Credit America's productive genius for the amazing speed with which, in one short year, old planes and new have turned out the numbers, the fighters, the transports we need. Credit too, for a vital share in the achievement, the speedy and accurate Bullard Vertical Turret Lathe. The greatest single reason we are turning 8 times as many V.T.L.s today as in 1942 is the vastly increased demand for them by the airplane engine makers.

When the war was won, there V.T.L.s will have plenty to do. It will take 300 times as long to turn them for the war of peace . . . for it is inevitable too, the V.T.L. is way up there.

Alfred J. Jones,  
Bullard Sales Corp.

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## Keep UP-TO-DATE On Developments

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save invaluable time, provides profit through convenience. To obtain literature or additional data on new products described, simply fill in form below,\* clip it to your letterhead, and mail. There is no cost, no obligation.

### INFORMATION TIPS

#### Milling and Boring Unit

From Taylor Bros. Co., Bridgeport, Conn., is available order table concerning company's high speed vertical lathe and jig boring machine. Described as both compact and versatile, machine features an invariable screw feed hand with direct reading page.

#### Aircraft Piston Bulletin

Engineering Monthly is Aircraft Piston's Bulletin is new bulletin issued by E. L. Dalton, Inc. Veterans & Co., Wilmington, Del., containing data on properties and applications of Iron's Lantz, Plastalloy, Dynalene, Nylon, and Buralene. Aircraft uses are specified.

#### Wireless Reducers

With just published manual, setting machine on its Vireo Reducers, B. J. Goodrich Co., Akron, includes special engineering work sheet. Letter is aid in providing data preparatory to installation of mounting to reduce vibration, shock, and noise in shop machinery, etc., etc.

#### Motor Maintenance

Issued by Demare Co., Huxley, Wis., is Bulletin Chart and Maintenance of Practical Emergency Motors. Text, photos and diagrams instruct operator in handling of many service requirements of these units.

#### Engine Control Devices

Provider of ballistics no machine control instruments for industrial firearms, rifles, and even has been published by David Co., Watertown, Conn. Lastest list items are items for insertion of future addition and revision regarding units.

#### Electric Reading Ring

Reading ring designed for use between any standard plug shell and wire should ring is tested in ballistics being mailed by Cannon Electric Development Co., Los Angeles. Photo and diagrams explain use, which may be employed with either flexible contact coupling or cable strip.

#### Other Machinery Features

Taylor Mfg. Co., Milwaukee, offers literature regarding its B-122 dynamometers, balancing machines, drilling machines, dividing heads, and H-122 drilling no device. Data are described and illustrated in request color folders.

#### Be Turret Mills

Proctor Electric's explanation of how share is available from Rogers Machine Works, Buffalo, N. Y., concerning company's "Proctor 40" vertical turret mills for boring, drilling and turning. High detail of photographs of machines is featured.

#### Chart on Filings

Special handy reference wall chart prepared by Weatherhead Co., Cleveland, illustrates company's AN standard table: universal, ballhead, knee, and pipe fittings, also charts and reference values and hydraulic retaining cylinders.

#### Carbide Tool Maintenance

Four sample ways to get longer life from carbide tooling are graphically shown in red, white, and blue poster-size wall poster put out by Vandeby Inc. and Corp., North Chicago, Ill. Photos are shown, and with correct speed, clearance angles, sharpening, and tool positions.

#### Adjustable Sprocket

Released by David J. Ross Co., Boston Harbor, Mass., is bulletin describing operation of Removable adjustable sprocket for milling machines.

#### Tool Trainers

Documented with illustrations, book series was placed in pamphlet as new design tool industry's contribution to war production. Released by National Ma-

#### chine Tool Builders Assn., Cleveland

under title Machine Tools.

#### Head Testers

Five amplifiers with output head test tubes, with 4 in. dial, read and accessories, covering ranges from 100 rpm to 15,000 rpm, are shown in Bulletin No. 720 from Remond H. Buhl Co., New York City.

#### Metal Cutting Manual

McKenna Metals Co., Lehigh, Pa., has issued illustrated 50-page pocket manual for metal cutting methods, operations, cutting tool applications, designs, styles, and tolerance experience in grinding wheel speeds.

#### Graphic Parts Separation

Carbons of "dag" etched graphite in separating parts without damage is described in Bulletin No. 495-1 from Allotype-DeLia Corp., Port Huron, Mich.

#### Die Stamping

Deputy Rogers Mfg. Co., Minneapolis, describes its work in new booklet A Booklet Die Stamping Service With- out Possibility for Error.

#### AN Connectors

Diagram and description of new connector's number codes for AN connectors 2000, 2005, 2006, 1000 and AN20000 have been published by Cannon Electric Co.

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APRIL

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## INFORMATION DPS

Independent Co., Los Angeles, to review Part A3 Standard Drawings Bulletin, which also contains catalog supplements, descriptions of positive rivets, bolts, straps, steel caps, and loading rings.

**Paint Protection** ..... 15  
Highlights of Atlas of Covalent Deques recommendations for positive protection

Ryersen Appointed by Aircraft Scheduling  
Unit of The Aircraft Production Board as

# Stock Source for Aircraft Alloy Steels

Ryersen Steel-Service Plants in Chicago, St. Louis, Cincinnati, Jersey City and New York are now carrying Aircraft Alloy Steels (Chromium-Manganese based) in stock under the ACW program.

These aircraft steels represent only a small part of the many thousands kinds, shapes and sizes of steels available at Ryerson. Ryerson engineers and metallurgists are always glad to work with you on problems of steel.

X4130 Rounds—Cold Finished—Heat Treated  
X4130 Rods—Cold Finished—Annealed  
X4130 Rounds—Hot Rolled—Annealed  
X4130 Shapes—Cold Finished—Heat Treated

4140 Rounds—Cold Finished—Annealed  
4140 Rounds—Hot Rolled—Annealed  
and many other alloys.

Aircraft Steels at Chicago, St. Louis, Cincinnati, Jersey City.

Other Plants at: Milwaukee, Detroit, Cleveland, Boston, Buffalo, Philadelphia.

# RYERSON

for structural plants are combined in *Paint Protection Part One* issued by OGD editorial services as Publication 1044.

**Aluminum Characteristics** ..... 19  
Tensile strength and characteristics of aluminum alloy castings are listed by Atlas Aviation Corp., Lancaster, N. Y., in a pamphlet *Alum Data "A-10"*.

**Electrical Equipment** ..... 22  
Electrical Characteristics in new 100-page book, available from Westinghouse Electric & Mfg. Co., East Pittsburgh, containing topics on machinery ratings, heat losses, and distribution systems and including them for larger loads.

**Tap Stripping** ..... 23  
Based on a letter of information "Tap Talker" from Greenfield Tap and Die Corp., Greenfield, Mass., is an illustrated bulletin on how to strip taps.

**Automatic Furling** ..... 23  
An outline for automatically attaching furling to low tension, 3000-psi die-casting weight, manufactured by recently established York Engineering Co., Waterbury, Conn., is described in folder now available from company.

**Position Drilling** ..... 23  
Specimens and patterns of material designed to make 2, 3, 4, and 5 gage bits with one pass of tap are presented in book *Position Drilling Machine No. 1* issued by Harsco-Rite Mfg. Co., Los Angeles.

**Coil Coasting Return** ..... 24  
Roger Todd, Inc., Cleveland, has published *Coil Coasting Return* and why reliability of the roller coasting return for loading and unloading work up to 2 in. round steel in rollers, rolling machines, presses, and grinders.

**Surface-Angle Plates** ..... 25  
Distributed by Thomas, Wilkins & Co., Cedar Grove, N. J., is descriptive booklet on its bench and floor model construction surface angle plates, which are guaranteed without distortion.

**Physwed Tester** ..... 26  
Simplicity of getting physical tests with method tester before welding is portrayed in folder prepared by maker, A. J. Brown Mfg. Co., Chicago.

**Conserving Rubber** ..... 27  
Twenty best suggestions for conservation of latex, lifting, etc., are contained in *How to Conserve the Life of Rubber* and *Rubber Goods*, booklet being mailed by Pioneer Rubber Mfg. Co., Los Angeles.

**Aluminum Welding** ..... 28  
Aluminum Co. of America, Pittsburgh, has issued *Aluminum*, 100-page book of information and suggestions for welding and brazing these aluminum.

**Little Fixtures** ..... 29  
Features of its automatic hydraulic, automatic, mechanical, and manual production lathes, chucking machines, and gunsmiths bar tools are presented in folder from Lips-Bellows Corp., Syracuse, N. Y.

**Steel Riveting** ..... 30  
In its *Handbook A-28*, Chicago-based Co., Los Angeles, presents applications, procedures, and tools for fastening its steel rivets in structures.

**Little Insulators** ..... 31  
Technical Service Dept., South Bend Little Works, South Bend, Ind., has prepared Bulletin E-4 containing illustrations, diagrams, and suggestions for the installation and leveling of the Little.

**Aircraft Engine Film** ..... 32  
Free motion pictures, Wright Aeronautical Corp., Dayton, N. J., has created a series of explanations of engine opera-

tions in booklet titled *Engine Operation Arrangements* for display of service can be made through Army Public Relations Division.

**Electrical Distribution** ..... 22  
Eachard Insulator method of electrical distribution is pictured, with specifications and suggested ratings for under and branch circuits, in Bulletin 422 issued by Bell Telephone Products Co., Detroit.

**Cashless in War** ..... 34  
First Cashless Products, Inc., Los Angeles, has played its spending war production is actually displayed in folder which also contains a printed list of their specialized industrial chemical requirements.

**"U" Flocking Chart** ..... 35  
The operating manual chart for any installation and step record of hydraulic and pneumatic "U" flockings has been compiled by Wayne Davis & Co., Chicago.

## Latest Machine Tools

**Automatic Contour Miller** ..... 37

Fast feeding, high speed cutting of aircraft aluminum alloy, extrusions, castings, and sheet can now be made apparent to one possible on the 400-4 automatic contour milling machine, produced by General Machine Works, Chicago. Fed to make of 13 and 15 ft. sections which may be held together in any desired multiple length. Operates 20-in. table surface. Designed to hold large "V" slots on this contour, allowing work to be clamped by air or hydraulic pressure from below table surface. Speed of the carriage, driven by 4-hp. motor, can be varied from 4 in. to 15 ft. 4 in. per min. Cycle automatic control, average speed is approx-

imately 40 in. per min. Controlled by the two horizontal and two vertical motor leads, which on the four combinations of operation, are mounted to carriage. Cuts are automatically controlled through guide wheels follow templates and up to desired shape (see diagrammed photo). Reproducible cuts can be maintained within .001 to .002 in. Specifications: Length over maximum of 75 or 35 ft., width 7 ft. 8 in. including tracks and steel guide. Weight 45-51, machine alone 20,000 lb., table 24 in. wide, height of carriage 70 in. Maximum clearance for horizontal cut-



## More Durable, More Feelproof Wood Aircraft Assembly

NOW POSSIBLE WITH  
NEW WOODEN "WARM-SETTING"  
PHENOL RESIN GLUE!



WE advise your attention about a new wood-glue placed forward in this new wood assembly—wood which you need exactly—exactly—when you need exactly.

**WARM-SETTING**—Proven, rapid, waterproof, long-term plastic glue.

**WARM-SETTING**—The glue is a slightly viscous, in a special 200-400 degree heat, it cures in 10 minutes, forming a strong, durable bond.

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**WARM-SETTING**—The glue is a slightly viscous, in a special 200-400 degree heat, it cures in 10 minutes, forming a strong, durable bond.

• We are glad to supply latest information on this new glue to assembly plants, on request. Address: Casco Co. of America (Dept. A4), 330 Madison Ave., New York, N.Y.

## CASEIN COMPANY OF AMERICA

### Aircraft Glues

Phenolic, Epoxy and Casein glues  
to meet all aircraft requirements



# NEW PRODUCTS

line 9 in., vertical 5 in. Working range from table to vertical motor 2 to 12 in.; working range from table to center of horizontal motor about 34 to 313 in. Maximum clearance of work 7 to high 20 in. wide—*Aviation*, Apr. '43.

# Oil Recyclers..... 33

Arcueil's Inco, Danco, and transformer oil recyclers with capacities up to 260 gal in 90 min are being marketed by Youngman Miller Co., Berkeley, O., which reports that machines reduce viscosity to new oil values and automatically remove sulphuric materials as indicated by ASTM precipitation tests. By extracting contaminants as well, they reduce dirt oil to original usefulness. Dirty oil is supplied to machine by automatic flow-controlled pump. Operator adds, automatic refills; earth, turns on electric light and heater, regulated by thermostat. Signal lights



indicate when oil and earth have reached proper temperature. Three operator controls oil through filter press, removes contaminated earth in dry coils—*Aviation*, Apr. '43.

# Double-Head Tapper..... 35

Illustrated here is double-head metal tapping machine manufactured by Balm-Wall Manufacturing Co., Los Angeles. Cookwell and may be used for tapping two different sizes of holes or for working on two different pieces, or one head may be equipped with a drill. Rotational arms make possible making of tap around work. Reversible clutch designed to protect tap life, pressure depth control, and flexibility in usage of materials and work finished are features. All electrical equipment is incorporated in base of the machine, as is the coolant pump. There are two tapping ranges, 71.6 to 268.5 on 60 cycles and 59.3 to 314.0 on 34 cycles (2-46 gear advance). Tapping capacities: Pipe tapers to aluminum, steel, plastic, brass, and mag-



# NEW PRODUCTS

nesium 4 to 3 in.; pipe tapers in steel machined metal and chrome only steel 3 to 4 in.; N. C. and F. thread in aluminum bronze, plastic, in steel stainless 4-60 to 3 in.; S. C. and F. thread in steel steel and in steel and chrome only steel 4-60 to 3 in. Supplied with accessories for some drives are single-speed tag two-speed 3-hp. motor. Maximum distance from center of spindle to column is 30 in. from spindle to table (spindle up) 25 in. and from spindle to table (spindle down) 12 in. Table size (horizontal) from 16 in. to 36 in., right to left, 44 in. Height with spindle raised is 50 in. and floor space is 36 in. Net weight of double-spindle machine is 5,360 lb., while shipping weight (crated machine) is 6,500 lb.—*Aviation*, Apr. '43.

# Flash Welder ..... 46

Interposition of "Pleatrol" insulator to prevent arc short circuits is feature of new flash welder produced by Progress Welder Co., Detroit. When short circuit happens, forward movement of plates is automatically interrupted, then reversed, thus being de-



signed to avoid line overloading and incomplete welds. Upsetting speed and pressure are provided by levers which flexure all into plates increasing operator—*Aviation*, Apr. '43.

# Jig Grinder ..... 41

Manufactured by Moore Special Tool Co., Bridgeport, Conn., is Haver Jig Grinder for finishing holes to size and location after material hardening, and thus increasing life. Parts of the grinder itself are hardened, ground, and lapped to create sustained accuracy rated at .0001 in. for straight and tapered holes at angles up to 35 deg in

# Carrying a Big Load of VICTORY

Advanced design advances in both piston and rings are meeting war's increasing consumption demands.

In this increasing forward drive engine design an example of the new design is the U.S. Super-Positive Piston Ring—engineered of the best available material in the most exacting standards—shown and beyond price and performance requirements.



Advanced CONSTITUTION Weight Options Available



For Ring Conditions Favoring Peak Performance...

Use U.S. Super-Positives

U. S. HAMMERED PISTON RING CO., INC.  
STIRLING, NEW JERSEY, U. S. A.

Contact MUST be maintained

# AIRCRAFT

comes in every phase of war are today depending upon radio operating efficiency for instructions while in the air. Victory or defeat, safety or disaster, often hang in the balance. Astatic Coaxial Cable Connections and Multi-contact Plugs and Sockets for aircraft radio equipment, make secure contacts and at the same time provide a modern, government approved method of almost instantly connecting or disconnecting electrical circuits. For speed and dependability in installation and service, Astatic products give top performance.

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## For every hero—one Blondel

**B**UT for the faithful Blondel, Richard the Lion-Hearted might never have returned from the Crusades... he would have died a prisoner in the Tyrol.

Today's heroes have their "Blondels," too... in the plants and factories that supply the equipment for war.

At Fleetwings, for example, the "Blondels" are building planes... sturdy Fleetwings have trainers for the Army's fledgling bird-men. And they are building parts... wings, fus, stabilizers,

aluminum, tail assemblies, fuselage sections, and hydraulic equipment for many of America's bombers and fighting planes.

Working with practically every aircraft material... with stainless and other steel alloys, with aluminum, with plywoods... the men and women at Fleetwings are fighting a supporting action that's felt all the way in Berlin, Rome, and Tokyo.

But today's production, vast and important as it is, is not all. The Fleetwings' pioneering that

developed the first all-welded, stainless steel military plane is continuing... unchanged. Victory will find Fleetwings qualified and ready to serve as "Blondel" to the air needs of the Peace.



(Inset No. 1)

**FLEETWINGS**  
Incorporated  
BRISTOL • PENNSYLVANIA



**FLEETWINGS**  
pioneers with parts  
and hydraulic  
equipment



The #77-25, all-welded fuselage trainer built for the U. S. Army Air Forces.

**A NEW ELECTRICAL GAGE**, capable of automatically measuring the winds developed during an on-fire test in use at Fleetwings to speed the testing of aircraft structures. With this device, it is possible to measure and make a permanent record of the stress developed on an element; price of a structure—oil within a single second.

**THE "ROCK" HAVE FLOWING** from our before never seen the advent of the new Fleetwings-developed Hydro-Lock. The Hydro-Lock, essentially, is a rubber vacuum cup with a lead or "rope" attached. Primarily designed for holding sections on vertical test benches where the lead weights or "rocks" are suspended, it has been found they are equally efficient on horizontal benches where they hold down the sections much more securely.

**FROM THE HYDRAULIC DIVISION** comes one of the basic series of parts which all Fleetwings hydraulic components are constructed before leaving our plant. Every fitting condition is duplicated during the test-and after function perfectly on our equipment. A "water-actuator line," for example, filled with dry ice, reproduces the shock and stress experienced in high-speed flying. Other tests reproduce single loads, make sure that the subject can bear general use, and stand body stresses of 1000 lbs. per square inch.

**"THE BROOM"** is the name given to the machine used by Fleetwings in producing precision hydraulic and electric series of instrument to meet and custom in the aircraft industry. If you'd like a copy sent directly, write an original company stationery, head your request in "The Broom," Fleetwings, Inc., Bristol, Pa.

**"KEEP 'EM FLYING!"**  
**FLEETWINGS**  
Incorporated  
BRISTOL • PENNSYLVANIA

## NEW PRODUCTS



other direction. Other specifications: Table range 9" x 14" in, table size 18 x 18 in. (not shown in photo); grinding capacity with wheels, 3/16 to 5 in., with standard legs 1/16 to 3/16 in.; grinding speeds 15,000, 25,000, and 45,000 rpm—Baltimore, Apr. '43.

**Press Welder**..... 42

Designed for high speed precision projection and general spot resistance welding of sheet and structural steel assemblies, wire, and non-ferrous materials, series P-50 and P-300 automatic, unattended press type welders have been added to line of Pier Equipment Mfg. Co., Boston Harbor, Mass. Processes obtained depend upon size of double-acting air cylinder and can be regulated from 500 to 4,000 lb. Pressure with "PT" dies hold projection welding close. For spot welding, machines are equipped with two 1/2 in. dia. by 6 in. replace horns mounted for 11 in. water-cooled electrode holders, of rigid cast-iron or all-steel positions. Standard throat depths 12 and 26 in. Capabilities, series P-50,



28 and 56 lbs., series P-100, 75, 100, and 180 lbs. STEEL types, 1, 2, and 3 (long) and copper controls available—Annapolis, Apr. '43.

**Automatic Riveter**..... 43

To replace hand grinding of heavy aircraft assemblies, binder spurs, and wing skins, General Engineering Co., Buffalo, has devised new automatic multiple riveter (Model GE-800) which sets fasteners, at an angle or parallel to axis of action when joints are held in a template. Material can be fed out in sequence on motorized feed rolls while the machine is operating. The two beds, fitted with single or multiple anvil, can be cut together in sequence and rolls shifted from automatic to manual control—Annapolis, Apr. '43.





## Shop Equipment & Accessories

### Striking Wire ..... 44

Used to heat materials together by method similar to disk stapler, new zinc coated striking wire developed by American Steel & Wire Co., Cleveland, has guaranteed minimum tensile strength of 200,000 lb. per sq. in., diameter of .051 in. Heat to produce steel .030 thick, diameter .049 in., strength 600, and softer materials such as rubber, wood, asbestos, and cork to 1 in., wire is reported particularly adaptable to the fastening of rubber, plates,

fire board, laminated wood and other construction materials to standard steel or aluminum "disks," says firm, "permits striking to be made at the site of several hundred per minute. Cold air ducts, fire and kilns, and nonconductive boxes also can be "wired" into their proper places by use of this material." *Aviation*, Apr. '43, -

### Check Valve ..... 45

New type universal check valve per-  
mitting valve examination to be made



with one hole and any two of three types of adapters in use in production at American Sewer Products, Los Angeles, under trade name "ASP." Designed for airplane hydraulic lines, valve is described as being 18 percent lighter and having two to four times greater flow capacity with corresponding reduction in back pressure. Adapters available for fixed taking, internal or external through. Furnished in all standard sizes of heat treated aluminum alloy tubing, it can be assembled to meet any combination of taking, connectors, or fluid flow direction. Laboratory tests of 34,000 psi pressure at temperatures up to 275 deg. F. report no breakdown or distortion.—*Aviation*, Apr. '43.

### Cleaning Fluid ..... 46

The Cerrus Corp., Malibu, Mass., reports new cleaning fluid faster than naphtha for cutting grease, larry dirt on metal parts insulated to reduce surface temperatures. It is a water-white methylene trichloride solvent described as non-corrosive and non-explosive, inducing no corrosion or staining on ferrous metals and less than that of methylene chloride.—*Aviation*, Apr. '43.

### New Magnets ..... 47

For moderate horsepower aircraft engines, Edison Spindler Corp., West Georgia, N. J., is producing S-16 magnets with low sparking performance at running speeds. Spring mechanism at drive end facilitates starting by increasing shaft speed while extending spark.



## NEW PRODUCTS

Known as Edison Jr. aircraft magnets, it appears by rotating magnet contact in single-unit, disc-aluminum housing.—*Aviation*, Apr. '43.

### Welding Control ..... 48

Rapidly constructed, eliminating vital materials and facilitating inspection and servicing, is feature of an electronic capacitor discharge resistance welding control announced by General Electric Co., Schenectady, N. Y., for aluminum resistance welding. Supply-



ing energy-storage principle, control provides high currents and short welding time required for this work. It consists of charging and discharging circuit, control station, Thyroned capacitor, and sequence control mounted in cabinet with full-length front doors (open in photo) and removable rear covers. Interior is protected by blast doors.—*Aviation*, Apr. '43.

### Multimeter Unit ..... 49

Added to instrument line of Radio City Products Co., New York City, a new multimeter (Model 901) has com-

# CONDUIT FITTINGS

TO ARMY AND NAVY SPECIFICATIONS



**POULSEN & NARDON, INC.**  
LOS ANGELES-CALIFORNIA

## BARBER-COLMAN CONTROL MOTORS FOR AIRCRAFT



For positioning flaps and valves on landing, cooling, and air flowing units, and for other control purposes.



B-C Control Motors are specially designed throughout for aircraft service. They are ruggedly built, in exacting specifications, to give precise performance under all operating conditions. They have hand wide acceptance by leading aircraft manufacturers. Write for Bulletin P-726.



**BARBER-COLMAN COMPANY**  
ROCKFORD - ILLINOIS





NO. 8 LOCK



SCREW THREAD



HIGH TENSION INSULATOR



SHELL

Win A War Bond! Tell Why

# "dag" COLLOIDAL GRAPHITE

IS IMPORTANT in the Manufacture of War Equipment

## How to Win

Acheson Colloids Corporation will give a \$25.00 War Bond to each of the 5 people who submit complete and accurate answers together with the 5 best letters on the question, "Why is 'dag' colloidal graphite important in the manufacture and/or use of the products pictured here?" (1) Best business correspondence here and in the graphite field or field families will be awarded (2) All entries must be legible (3) All entries must show the publication in which the advertisement was seen. (4) Entries must be postmarked not later than June 15, 1945 (5) In case of ties, duplicate awards will be made (7) Entries become the property of the Acheson Colloids Corp. (8) The vendor of the prizes will be listed.



Write for Booklet #21-22  
"dag" Colloidal Graphite for  
Assembling and Running  
in Engines and Machinery

ACHESON COLLOIDS CORPORATION

PORT HURON • MICHIGAN



## NEW PRODUCTS



trinity of 36,000 shots per volt on all d.c. units, 1,000 shots per volt on a.c. With over 100 use of 1 x 10 x 2 in. never has range of 0-25/50-250-1,000-5,000 on d.c. and output voltmeters, 4,500 on d.c. instruments, 6,110-180,000 on d.c. milliammeters, 6-1,000-100,000-1,000,000 on voltmeter, and -10 to 30 on dual meter—Aviation, Apr, '45.

## Phenolic Plastifier ..... \$0

Zabitz Corp., New York City, announces new phenolic molding plastic, B31-16014, for long life extreme work and transfer molding and new phenolic molding material, B31-16017, designed especially for aircraft and automotive injection molding—Aviation, Apr, '45.

## Converters to Screws ..... \$1

Designed by Kender Aero Products Co., Burbank, Calif., its convert small and medium sized lathes into the speed range of hand production screw ma-



... AND SUDDENLY SOMEONE YELLS



# FIRE!

A splash of gasoline... a spark... and there's a blaze racing smok, threatening vital American battleplanes.

But as soon as the siren sounds, the peril can end... if a duGas fire extinguisher is near at hand to conquer the fire, quickly and decisively.

## DUGAS GETS RESULTS FAST!

In contact with fires, duGas releases green blankets of gases which have a powerful flame-killing effect. duGas is always ready for use in a split second... it never hardens, freezes or evaporates. Long storage won't cause it to go stale... it is unaffected by damp or dry air. Moreover, its use produces no toxic gases. duGas is harmless to everything except fire!



Available in Model 100 and 1000 duGas fire extinguishers. Models 100 and 1000 duGas fire extinguishers. Models 100 and 1000 duGas fire extinguishers.



Model 100 duGas fire extinguisher. Model 100 duGas fire extinguisher.

DUGAS ENGINEERING CORPORATION • MARINETTE, WISCONSIN

Owned and Operated by Aerial Chemical Company



**WANTED!**  
300 WELDING OPERATORS  
IN 10 DAYS

TANK TREAD SHOES, are now welded on assembly lines by women using Westinghouse A-C welders. Treads are put on in 30 to 40 minutes and moving tire welding heads when 34 inches of downward welding are applied to each.



"We found the answer in untrained women

...and A-C WELDERS," says Chief Electrician of large War Plant

"Production-line welding in 10 days by women operators who never struck an arc before? A few days ago we would have thought it impossible. Today, it's a fact!"

So states this official, who has supervised the training of more than 600 women welders, for producing tank tread shoes on seven continuous production assembly lines. The average woman worker quickly learns how to strike an arc and run short leads—from then on she practices, practices, practices welding tank tread shoes. Usually in ten days she is ready for actual production welding (work must pass head tests)—where her initial work is carefully supervised by her instructor.

"One of the biggest factors that has made it possible and successful," says this electrical engineer, "has been the use of five welders. We bought them originally because they were immediately available, although we had always used d-c."

"We found, however, that the freedom from arc blow made it much easier to develop qualified operators. Weld quality is excellent. Most important, we've had literally no maintenance in nearly a year of 24-hour-a-day average operation."

The 275 Westinghouse A-C 300-ampere welders in operation at this plant are just a few of the many Westinghouse welders that are solving problems of availability, ease of operation and freedom from maintenance for many war plants. Ask for booklet W-12138, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Westinghouse A-C WELDERS**  
PLANTS IN 21 CITIES...ARTIFICIAL LIGHTHOUSE

times are collected during attachment and removal. Former handles bar and tubing stock from 1/32 to 1/2 in. dia., clamping and releasing work while left hand. Used in conjunction with other clamps, cross slide provides forming and cutting. Adaptable for Allen, Crutcher, Shark Head, Logan, and similar lathes of 2 in. spindle capacity—AVIATION, Apr., '43.



#### Vacuum Tester.....52

Patented by Leeman Bros., Newark, N. J., and designed to test instruments such as differential gages, critical bearings, and altimeters is a vacuum and pressure unit (photo above). Machine is also equipped, provided with automatic lubrication and controls to adjust vacuum and pressure as desired—AVIATION, Apr., '43.

#### Vacuum Pump.....53

Available from American Automatic Transformer Co., Chicago, is vacuum pump in two standard sizes, 15 and 7 cu. ft. at 4 in. of mercury. Four bellows, mounted within square cast-iron frame, are driven electrically through connecting strips attached to a shaft and by a "V" belt to motor. Shaft

speed approximately 200 rpm. Each type of pump is equipped with governor to prevent wear when they have reached their exhaust capacity—AVIATION, Apr., '43.

#### Drawing Board Top.....54

Necked drawing board top, a special cover for drafting boards, being marketed by W. H. Leck, Co., Chicago—AVIATION, Apr., '43.

#### Winter-Tread Tire.....55

Photo shows C. J. Bentley, Good-year Tire & Rubber Co., Akron, inspecting status of plant tire he designed to reduce skidding on snow and ice. It is covered with wire mesh which becomes tiny ridges when the tread is compressed in place—AVIATION, Apr., '43.



#### NEW PRODUCTS

**WANTED!**  
500 WELDING OPERATORS  
IN 10 DAYS

#### for PRODUCTION A-C WELDING

Whether it's a problem of training new operators, or of improving on some weld quality, Westinghouse A-C welders, with their Breakdown Bars are here, to help you. 150, 200, 250 and 300 ampere models. Also 3000 ampere models for use with the Cincinnati process.



#### D-C WELDER with ARC CONTROL

Single, pre-set current adjustment. Lots of capacity to handle all kinds of work. No drop-off after warming up—line test machine making single currents: 200, 250, 300 amperes.



#### MULTIPLE-OPERATOR SETS

Do the work of 25 to 30 single-operator machines. Stationary types for shop operation—semi-portable types for use on ships and smaller applications. Ask for complete data.



#### PORTABLE TACKING PANELS

Compact, single-operator control panels for 25-30 work with single-tack operator sets. Extra capacity for light tack welding. Write for latest literature: Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Westinghouse WELDERS**  
PLANTS IN 21 CITIES...ARTIFICIAL LIGHTHOUSE



## THE *Boost* THAT PUTS THOUSANDS OF H. P. INTO ACTION . . . .

As these boats, under various conditions, are loaded to airplane motors alone possess real position. To say so, speed is not enough without equipment. "Boost" is not, powered by dependable Briggs & Stratton gasoline motors. This is not one of your "one-of-the-ordinary" applications while, with scores of more familiar uses, with up to a more important list of ways the same boats are being used by Briggs & Stratton motors.



As an emergency machine service, we are trying to make "used" Briggs & Stratton motors that may not have been in service for the benefit of those who need them so badly.

Do you know of any Briggs & Stratton 4-cycle, air-cooled gasoline motors — no matter how old — that are not in active service? If so, please write us, giving size, model number, and a request for a general condition. We will serve as a "clearing house" to make contacts between owners and prospective purchasers.

BRIGGS & STRATTON CORP.  
MILWAUKEE, WISCONSIN U. S. A.

Send the Star  
found in  
U. S. War Bonds



BRIGGS & STRATTON

POWERED MOTORS

### NEW PRODUCTS

#### Straightening Press . . . . . 56

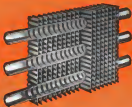
Design of high speed straightening press by Anderson Bros. Mfg. Co., Hartford, Ct., is reported to eliminate necessity of working shaft ends in centers for straightening, which is done to



same position as bending. When bending pressure is released, spring pressure on rolls allows shaft to return for straightening. Indicator gauge is calibrated in thousandths of an inch. Pressure applied by hand hydraulic pump with capacity is 70,000 lb., measured on pipe subjected in its. Straightener straightens handles shafts to 35 in. dia. Manufacturer also plans to produce larger models. —ANDERSON, Apr., '43.

#### Ventilating Boilers . . . . . 57

Glenn B. Schenck Co., Green, manufactures several models of low draft ventilating boilers, including



THEY'RE  
SHOCK  
PROOF

# Only McQUAY gives you RIPPLE FIN COILS

More STRENGTH More DURABILITY More EFFICIENCY More HEAT TRANSFER

TO MEET the exacting demands of Navy specifications, McQuay engineers added the Ripple Fin to their Ripple Tube to enable McQuay coils to withstand the shock of heavy guns. This type of construction, together with the all non-fusion welded header pioneered by McQuay meets the

new Navy standards. These shock-proof McQuay coils have been and are being supplied to U. S. Navy yards for the Navy's fighting ships. When you have special heat transfer problems — look to McQuay for the answer. McQuay, Inc., 514 Broadway Street N. E., Minneapolis, Minnesota.

McQuay INC. AIR TEMPERING EQUIPMENT  
ESPECIALLY DESIGNED FOR INDUSTRY



AIRCRAFT  
HEATING ASSEMBLY



CONVECTOR  
RADIATOR



CANTONMENT  
HEATING UNIT



VENTILATION HEATERS  
NAVY TYPE



AIRCRAFT  
HEATING SECTION





## Wherever man goes . . . you, too, from the snowfields of the

Arctic, his voice now carries to the outer world through the two-way radiotelephone. In the future, you'll use the radiotelephone as a safeguard, as a convenience, as a business advantage. We are proud of the fact that Jefferson-Travis has pioneered in this form of radio-communication and has contributed to the science of electronics new and exclusive developments that are proving an invaluable aid to the United Nations on every front throughout the entire world.



**JEFFERSON-TRAVIS**  
RADIOTELEPHONE EQUIPMENT

NEW YORK • BOSTON • WASHINGTON, D. C.

## NEW PRODUCTS

portable types, for hand grinding, barring and chipping magnesium castings. Working surface is hard wood grating, cranes and end sheet are intended to reduce side draft and increase ventilation. V-shaped bottom hanger acts as exhaust duct which can be flushed with oil in semi-hazy conditions. *Aviation, Apr., '43.*

## Simple Couplings . . . . . 58

New line of "Quick Disconnect" couplings for fuel, oil, cooling and lubricant lines is announced by E. J. Wiggins Oil Tool Co., Inc., Los Angeles. Made from 11KT and 24KT aluminum for aircraft and from brass for ground use, couplings are available in all required sizes and designs for connecting tubing and hose in any instru-



ment connection. To disconnect, handle ring is pulled backward, releasing dogs on female half from their grip on locking ring on male half. To connect, the handle ring is rolled back, compressing a coil spring behind it, and permitting the dogs to open, then the halves are pushed together and the handle ring is advanced to force dogs down behind locking ring and held there at that position. Setting is accomplished by a rubber gasket on a shoulder within the female half. *Aviation, Apr., '43.*

## Fire Fighting System . . . . . 59

Curtiss develops fire extinguishing system to be installed in engine nacelles are being made by Walter Kilde and Co., Bloomfield, N. J. Gun, stored under high pressure in steel cylinders, can be released by action on gun's compartment. *Aviation, Apr., '43.*

(Turn to page 36)

AVIATION, April, 1943



## "E" for Excellence

☆ In receiving this joint citation of the Army and Navy, the management and personnel of The Weatherhead Company recognize that the award carries with it not only an honor but a grave responsibility. We will discharge that responsibility by making every effort to increase the flow of vital parts for 'planes, tanks, trucks, ships, combat cars, radios and munitions which Weatherhead plants have been turning out at the rate of millions every day!

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# Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO  
*Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries*

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# RIGHT DRESS!

RIGHT DRESS® for abrasive grinding wheels is sometimes hard to obtain. When grinding wheels are to be dressed to close tolerances, the dresser must be sturdy, flexible, accurate and fast.

RIGHT DRESS® can be obtained, easily and rapidly, by using the VINCO (B-1) ANGLE TANGENT TO RADIUS DRESSER, which combines all of the above requirements. It incorporates the basic patented principle of dressing radii, angles, and angles tangent to radii on abrasive grinding wheels, from the same axis without removing the diamond.

RIGHT DRESS®, with the VINCO (B-1) DRESSER is accurate to within .0001", reducing time and expense, and giving trouble-free service at all times. This dresser can be adapted for use on all surface grinders, and on most external, internal and cutter grinders.

Remember, the RIGHT Dresser, the RIGHT operator, the RIGHT grinding wheel, mean the RIGHT DRESS, the correct and accurate form for every dressing operation.

**VINCO CORPORATION**  
8865 SCHAEFER HIGHWAY  
DETROIT • MICHIGAN

MILLIONTHS OF AN INCH  
FOR SALE BY  
**VINCO**



## Jetted Relay ..... 40

Cool, balanced sensitive relay, made by Deek Electric Co., Chicago, to avoid side with various contact arrangements



(up to 12 springs on each side) in various switches. Capacities up to 5 amp., 110 v., a.c., coil capacities 10-100 ohms, each. Dimensions 1 1/2 x 1 1/2 x 1/2 in.—*AVIATION*, Apr., '45.

## Hydraulic Test Bench..... 41

Stom for two operators and is most precise position for assembling a fluid in general at a very low rate. Test bench manufactured by Hydraulic Machinery Co., Detroit. Designed pro-



aply for shaking strength testing, bench delivers pressure up to 10,000 lb. per sq. in. and contains variable delivery pump and capable of supplying 10 gpm. per min. Air-ol. separator, vented by small high pressure hydraulic-driven air compressor, checks valves at maximum of 1,000 lb. per sq. in. and can also charge accumulators already installed in place.—*AVIATION*, Apr., '45

## Torque Wrench..... 42

Offered by Teking Tool-Gap, Inc., Los Angeles, ten torque wrench designed for applying proper torque load



to taking 1/2 inch in closely plugging pipe middle and plugging rigid when gas decreased load has been reached. Employs spring bar detection principle. Deflection in main bar bends secondary spring which trips over center when desired load is reached, causing slight drop in torque valve, a click and rotation of bottom (arrow in photo) in operator's hand. Trade name: Laramore Torq-Snap, it will eventually be available in models for use on engine valves, cylinder head and connecting rod bolts, spark plugs, etc.—*AVIATION*, Apr., '45

## NEW PRODUCTS

## Protector Valve ..... 43

To avoid danger of any other seal's shoring pressure from leading wheel lockup, Tex Manufacturing Co., Los

## IT'S THE POSITIVE MECHANICAL ACTION

## THAT COUNTS IN A

# Blind Rivet

Shank expansion fills all imperfections giving high strength in finished rivet



## THE CHERRY RIVET HAS THAT ACTION

The self-plugging Cherry Rivet is used in the hard-to-get or places in new airplane construction, in airplane salvage work and in field repair. No locking bar is needed. Application is fast and the resulting joint has high shear and fatigue values.

The phone dialing of an LS 1128 Countersunk Cherry Rivet is

double dimpled shank shows how the mechanical forces exerted by the material in the riveting process hold the sheets together and expand the rivet shank to fill irregularities in the hole.

**WRITE FOR NEW HANDBOOK...**  
A new 16 page handbook, giving all the facts on Cherry Rivets and how to apply them, is available on request. Address: Department 1, Cherry Rivet Company, Los Angeles, California.

CHERRY RIVETS, TRADE MARKS AND APPLICATIONS ARE COVERED BY U. S. PATENTS 2,048,400 AND 2,048,401

**Cherry Rivet**  
Company  
LOS ANGELES, CALIFORNIA





With this new Exhaust Heat Exchanger...

AIR FROM ATMOSPHERE

TAKES ON HEAT FOR WARMING AIR TO CABIN

HOT EXHAUST GASES

TO TURBO-SUPERCHARGER

TAKES OFF HEAT FOR TURBO FLAME-DAMPING

AiResearch engineering provides  
two more advantages for U.S. aircraft.

"Put control on air in doing new jobs... find ways to make it do old jobs better." This is a special year word assignment to a group of AiResearch engineers. And their most recent answer to the challenge is the AiResearch Exhaust Heat Exchanger.

Made of corrosion-resistant steel

and simple in design, this new lightweight unit weighs less a fraction more than the section of exhaust pipe it replaces. It is complete in itself, requires no auxiliary equipment. And operates with little or no drain on engine power because back pressure is minimal.

To U.S. airplanes, the AiResearch

Exhaust Heat Exchanger offers such advantages as these:

**Simplified method of Cabin Heating.** Heated air is ducted from Exchanger through an "interheater"—that it warms counter-passing air to cabin, without danger of carbon monoxide contamination.

**Power-conserving Flame-damping.** Thanks to its low backpressure, the AiResearch Exhaust Heat Exchanger can be kept in constant use for cooling turbo-operating exhaust gases. With practically no loss of engine power!

This new AiResearch development is now available to all U.S. aircraft manufacturers. Plus the assistance of AiResearch engineers in solving air, temperature and pressure control problems for specific aircraft designs. Inquiries are invited.

**AiResearch**  
MANUFACTURING COMPANY

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DIVISION OF THE HARTNET CORPORATION

"Where Control Air Goes the Jet" • Automatic Tail-Ramp Control System • Engine Oil Cooling System • Supercharger Aftercooling System • Engine Control System

NEW PRODUCTS



Aviation, has developed new hydraulic pressure gauge. It is fitted with spring-actuated bell to hold at start against 700 lb. or other predetermined pressure. Needle has zero area so only, passes through body, can read long time to atmosphere. Mounts pressure on delivery side drop below 100 lb. valve shaft, preventing use of other coils and removing whole oil supply for broken.—Aviation, Apr. '58

Chip Picker-Upper..... 44

Illustrated is hand propelled model known as Industrial Sweeper Division of Mole-Mover Co., Detroit, which picks up metal shavings along with (Turn to page 44)



## Speed Working Tools for Precision Operations

New and Old Workers find SPINTITE the fastest wrench for speedy assembly of small parts.

Standard sizes with hex sockets from 3/16" to 5/8". Keenled Round and Square Sockets available on special order. SPINTITE works like a screw driver.



751 Set in Leatherette Roll includes 7 SPINTITES 3 screw drivers and chuck type handle

**STEVENS WALDEN, INC.**

481 SHAWMUT STREET

WORCESTER, MASSACHUSETTS, U. S. A.





## TOMORROW

### behind a Wickwire Automatic Propeller

TODAY the only aim of this constant speed, lighter weight propeller is to help win the war.

TOMORROW its fully automatic pitch change is destined to help America's deadly-size planes produce more and faster miles per gallon. By making the operation of such planes simpler, and more economical it will help to speed the day of universal flying.

#### WICKWIRE SPENCER AVIATION CORPORATION

Blue Island, Illinois

(Subsidiary of Wickwire Spencer Steel Company)

## HERE'S PROOF OF THE SUPERIOR PERFORMANCE OF

# Gulf Cutting Oils

A FEW OF THE HUNDREDS  
OF SIMILAR CASES IN GULF'S  
FILES

**Gun Barrels . . .** Correlated by a large Ordnance plant on the possibility of obtaining greater production in the machining of cartridge chambers in .11 gun barrels, a Gulf Lubrication Service Engineer recommended Gulf Electro Cutting Oil A. Results: production of reamed barrels increased 1300%—rejections reduced 94%.

**37 Nos. Shot . . .** A manufacture of 37 nos. shot increased production 50%, reduced tool regrinds and down time for machine maintenance 50%, reduced cutting oil consumption 50%, and obtained better finishes on the work through the use of Gulf L. S. Cutting Base B blended with Gulf Cut-Aid.

**Turbine Gears . . .** By using the cutting oil recommended by a Gulf Lubrication Service Engineer, a manufacturer of turbine parts increased output 41%, improved finish, and reduced rejects in cutting Mosel steel gear blanks.

**Tooth Tread Pins . . .** A manufacturer of tooth tread pins increased production per tool drawing from 85 pieces to 600 pieces by using Gulf Lasepar Cutting Oil C.

**Artillery Recoil Cylinders . . .** By using Gulf L. S. Cutting Base A, a large Ordnance plant increased production 16% and increased tool life 100% in machining operations on hardened nickel chrome steel forgings for artillery recoil cylinders.



**Steel Drill Bits . . .** Consulted by a manufacturer of steel drill bits for bolts on the problem of 100% rejection of production due to worn threads in a tapping operation, a Gulf Lubrication Service Engineer recommended Gulf Lasepar Cutting Oil A and a suitable level on the end of the tap. Results: rejections entirely eliminated, production greatly increased.

As a result of proven performance, over a thousand plants with difficult machining operations have adopted Gulf Cutting Oils during the past six months. Here's the record of improved machining practice in these plants. Production increased as much as 100%, tool life increased as much as 300%, and marked improvements in finish. Write or phone your nearest Gulf office today for effective help on your machining problems.

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Gulf Building, Pittsburgh, Pa.



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Please send me, without obligation, a copy of the new booklet: "Gulf Cutting Oils," which includes a 16-page Machining Guide.  
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Company \_\_\_\_\_  
Title \_\_\_\_\_  
Address \_\_\_\_\_



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*Internal HEX Wrenching*  
**BOLTS**

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HARTFORD, CONN., U.S.A.

del and dot at maximum rate of 16,000 sq. ft. per hour in open areas. Also available are larger automatic trowel models (2 and 51 hp.) with optional rollers—VICTOR, Apr. '43.

#### Reciprocating Sander.....65

"Krolo" Division of The Eastern Corp., Harris, Ill., has developed a reciprocating sander for small wood



work at 3,000 oscillations per min. Believed so that it sand will be guided along work, sander comes ready to plug into standard outlet—VICTOR, Apr. '43.

#### X-Ray Solution Cooler.....66

Model 555-7D refrigerating and non-leak solution for the cooling of remaining solution equipment in the developing tank of industrial X-ray machines, also provides large volume of water for washing of film, according to manufacturer, Tangle Products Corp., Detroit. Water circulates through system using on-way wet gases from water inlet and, pre-cooling it and then recirculating much cooler refrigerating apparatus. Then it can be used in film washing process. Adjustment handle on outside of unit (bottom center in photo) can be set for either

#### NEW PRODUCTS

cool 35 deg. or 45 deg. for quick cooling of fresh specimens—VICTOR, Apr. '43.

#### Socket Wrench.....67

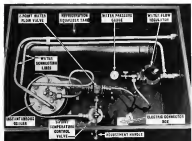
Two fine-tuning slots act as clutch in this rotating socket wrench, locking its tightening pull at desired level before slipping. Minimum extra motion before engaging or disengaging 1.5



deg. counterbalance 1.5 deg. Operation reported unaffected by oil or dirt (adjustable in four sizes, 1, 2, 3, 4 in. from P & H Manufacturing Co., Los Angeles—ARMSTRONG, Apr. '43).

#### New Steel Caster.....68

Reps-Standard Co., Grand Rapids, Mich., is manufacturing "Versa Steel" casters for portable tanks, drums, and



## BE ACCURATE



Accuracy starts with—on the battle line and on production front. Precision positive precision with Challenge equipment!

### USE

## CHALLENGE



## Semi-Steel BENCH PLATES

These plates provide a smooth surface for assembly, layout and inspection, and tool room operations—particularly on small parts. Made of special, annealed semi-steel with all sides machined at right angles to the top. Two, three, and six inches thick. Standard sizes in the two-inch plate range from 6x10 up to 26x54 inches. Four-inch plates from 12x22 to 48x72 inches, six-inch, from 12x12 to 24x54 inches. Other practices ground for to 36x60 in. at planar finish. Special and larger sizes to order.

\*\*\*

## CHALLENGE SEMI-STEEL SURFACE PLATES



Provide a true surface for tool making, inspection, and testing purposes, also reliable master plates. Challenge Surface Plates are made of strong, stress-treated semi-steel, specially heat-treated. They have three-point suspension and heavy, deep ribs on the underside which form triangular supports for the top surface. Will not give or sag under load. Finished with hand-scraped or precision ground. Full-hand wooden protective cover supplied with each plate.

THE CHALLENGE MACHINERY CO.  
CHALLENGE  
GRAND RAPIDS, MICH. U.S.A.





## YOU CAN GET 5 TRU-LOC BALL-TYPE TERMINALS FOR AIRCRAFT IN THE PRODUCTION TIME NEEDED TO MAKE 1 "B" OR "C" TYPE TERMINAL

Further, 1 Type "C" Terminal requires as much Bar Stock as 10 Ball-Type Terminals—the combination of Ball-Type Terminal and the yoke or rod and used with it requires only 32% of the material needed for a Type "C" Terminal—and Ball with shank (as illustrated) plus yoke or rod and cost much less than Type "C" Terminals.

Yes, these TRU-LOC BALL-TYPE TERMINALS can help you get away from slow bottlenecks.

1. They use much less of the critical materials.
2. They require but 32% of the productive time—and there is a shortage of equipment used to make terminals.
3. You can get them faster.

There remains but one possible question—the matter of strength. We cover that with the all-inclusive statement that "TRU-LOC BALL-TYPE TERMINALS WHEN PROPERLY SIZED TO THE CABLE HOLD TO THE STATED BREAKING STRENGTH OF THE CABLE."

The other advantages of BALL-TYPE TERMINALS—one of us in close quarters, etc.—are in addition to the important reasons for adopting them now.

Glad to cooperate with further information. Phone, wire, or write.

\* This illustrated 8½ x 11 folder gives exact data on to sizes, types—most of the facts you will want for your data file. If you do not have a copy, just ask for it.

### AUTOMOTIVE AND AIRCRAFT DIVISION

8-325 General Motors Building, Detroit

AMERICAN CHAIN & CABLE COMPANY, Inc.  
BRIDGEPORT • CONNECTICUT



### Felt Finishings..... 71

Substitution of felt finishings for rubber, copper, and other material.



### NEW PRODUCTS

Tools as exemplified in this photo from Western Felt Works, Chicago, (found on way to new "overhaul" on an important power-plant assembly part)—AUTUMN, Apr., '63.

Don't make. Featured are two large diameter ball bearings. Centers are finished with metal or ABR Resinoid floor protective wheels. Roller bearings are standard in most models, and roller or power steel bearings are available for metal wheels. Wheel sizes 3 to 6 in., most satisfactory operating load 500 to 800 lb. per wheel—AUTUMN, Apr., '63.

### Flexible Drill..... 49

First portable economical of use. This portable electric drill which has been produced for the Army for nearly a year has been made by manu-



facturer, Independent Pneumatic Tool Co., Chicago. Grip handle and feed and gear are made of specially-developed tough, light weight plastic—AUTUMN, Apr., '63.

### Radial Flexible Shaft..... 70

Intended for use where suspension type machines are difficult to hang or where there is no room for bench and floor models, radial type flexible shaft made by Wipacraft & Staff, Chicago, consists of motor, belt, and flexible shaft which revolves on stationary shaft over operator's head. Radial advantages available on all company's flexible shaft machines from ½ to 2 hp—AUTUMN, Apr., '63.

## GLOBE DISAPPEARING HYDRAULIC HOIST ACCOMMODATES ALL PLANES

Three Traveling Units, Each  
12,500 to 60,000 lbs. Capacity

The Globe Type A, 3D Airplane Hoist provides a smoothly operating, easily controlled and universally adjustable means of lifting all sizes of planes for quick, facile assembling and servicing. Hoist, connecting under wings and tail (or nose), is used to "free wheel" plane for checking and repairing retracting mechanism, brakes, tires, etc., or to level and position plane for final adjustment of instruments, cover and controls. The three oil-hydraulic hoist units travel on rails or jacks tapered with hinged over plates flush with the floor. Each unit has a lifting capacity of 12,500 to 60,000 pounds and provides a lift to 135 inches from floor level. Other types of Globe Airplane Hoists, both portable and stationary, are shown in a newly published catalog. For your copy, or for further information, write our Philadelphia office: Mermaid Lane of Queen Street.

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**GLOBE**  
HYDRAULIC AIRPLANE HOISTS



In Business for Your Safety





## KOLD-HOLD Rivet Machine

### Cuts Rejects!

Keep aluminum alloy rivets in stress at -45° F. and cut inspection rejects as much as 10% to 50% . . . with KOLD-HOLD Rivet Storage Machines.

Stored rivets drive faster, are less subject to head cracks—fewer have to be drilled out and replaced. Speed production, too, with rivets stored right where they are used. Handy tabs necessarily classifies rivets—permits storage up to moment of use.

Where large quantities of rivets are used, large KOLD-HOLD rivet storage units are at stalling stations, and small portable KOLD-HOLD units carry rivets to departments.

Whatever your rivet storage or industrial sub-zero processing problems may be, investigate KOLD-HOLD. Get complete details, NOW.

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Chicago—301 N. Wells—Evanston, Ill.  
Los Angeles—300 W. 6th—Glendale, Calif.

**KOLD-HOLD MANUFACTURING CO.**  
4110 Grand Ave., LANSING, MICH. U.S.A.

### Duct Clamps . . . . . 72

Lightness and its positive required reinforcement locking that ensure equal pressure at every point, are features reported by **Moscow Products Co.**, Indianapolis, 46101, regarding new



type of air seal of duct clamps. With diameters ranging from 1½ to 36 in., clamps are made for square, oblong, round, and triangular joints as well as odd lines and can be installed without heating joints.—*Aviation, Apr. '51.*

### Rivet Retriever . . . . . 73

Reinvents for a machine which cuts according to thickness, head type, and length, several rivets dropped by work men are available from **Palmer Rust Division of General Motors**, Detroit, which developed device. Three rivets are being used for thickness. Another handle has been perforated in electric units of every thickness used in Palmer plant. Other machines that sort for head type and length.—*Aviation, Apr. '51.*



### NEW PRODUCTS

### Acetylene Generator . . . . . 74

Recently introduced in this country by **Adler Manufacturing Co.**, Milwaukee is acetylene generator employing the deep outside water-seal principle. Available in two sizes, 80 and 200 cu. ft. shipping weights 70 and 150 lb., respectively.—*Aviation, Apr. '51.*



### Tire Tool . . . . . 75

The retractor tool of **New Britain Machine Co.**, New Britain, Conn., is reported fitted for all standard tire center case on planes, cars, buses, and tractors. Prevents on hard head tire from being too deep under well of rim, and the tool is then used to remove tire. Length 36 in., weight 3 lb.—*Aviation, Apr. '51.*



## Redesigning packing cases saves steel and shipping space

Information supplied by an Industrial Fabricator

A case in point is what has recently been done by a large manufacturer of airplane engines with respect to a matter normally considered of small importance.

New packing cases have been designed which feature simplicity of construction, added strength and materials-conservation. Concerning the latter—an extremely important matter right now—it was found that the substitution of two thin metal bands for the former outside bolted strapping and lifting eyes has saved over 500 tons of steel annually.

A slight reduction in the overall dimensions of one size of case now permits 25 cases of this size to be packed inside a typical height car, whereas only 19 could be so packed formerly. Countermark case handles, and the elimination of other previously-used protruding hardware, offers a smoother exterior, more compact storage, and less likelihood of damage to adjacent cases.

Simplified design makes it possible for four basic cases to care for the shipment of all engine types, whereas eight were formerly needed.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.  
MOLYBDIC OXIDE BRIGETTES • FERROMOLYBDENUM • CALCIUM MOLYBDATE

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their "target for tonight" . . .

## WEEMS STAR CURVES

THE WEEMS SYSTEM OF NAVIGATION was established in 1928 and is based on the patents, copyrights, and developments of Lt-Commander P. V. H. Weems. It has been expanded to cover the entire field of sea and air navigation. The outstanding contributions by Commander Weems include the Star Altitude Curves, the Line of Position Book, the Second-Second Watch, the Gold Medal Test Book *Air Navigation*, *Marine Navigation*, improvement in the Bureau of Standards Type Aircraft Sextant, the Design of the Air Altimeter, numerous articles, etc., etc. To those interested in celestial navigation we will be pleased to send complete data fully describing the books and instruments and connection with the Weems System.

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ANNAPOLIS, MARYLAND

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Altitude Plotter, Mark II,  
Simplified Celestial Navigation,  
Womers and Log,  
Air Navigation System, Entire  
Line of Position Book, Womers  
Byron Line Chart, with booklet,  
Air Altimeter, for 4 months,  
Radius of Action of Aircraft, Search,  
Marine Current  
Second-Second Watch,  
Marine Navigation, Womers  
Link Averaging Bubble Sextant,  
Instrument Flying, Womers and Entire  
WEN Course and Distance Plotter,  
Air Navigation, Womers,  
Star Altitude Curves, Womers, per 35"  
lat. Band*



LINK  
AVERAGING  
BUBBLE  
SEXTANT

## NEW PRODUCTS

### Slit Fastener . . . . . 76

Invention in metal fastener by principle of compression of metal also known after invention method of bolt in fastener of new design patented by David Mfg. Co., Watertown, Conn. Most trusted used to secure wear by plate on, to use, gripped by standard fastener plate and wedge inserted in hole where it acts as lock, being then up. Slit fastener is compressed. An outside screw releases that it has locked into place. Complete filing of the hole



provide lateral motion of fastener, and spring compression for various thicknesses of steel. Made of non-oxidized materials, fasteners are available for sizes, 3/32, 1/8, 3/16, and 1/4 in. dia. Majority of parts used in these sizes are interchangeable.—ASTORIA, April 31.

### Grinding Fixture . . . . . 77

New robot grinding fixture designed to speed up conventional grinding operations has been designed for aircraft industry by Industrial Grinding Co., Los Angeles, Calif. Will handle components of all types, center drills, integral pilot centers, and pilot drills, outer rings, or left handsets. Its ray standard grinder on work from 1/2 to 1 in. dia. 1/16 of angle size is variable from 0.01 to 1 in. and adjustment pins are provided for 1, 3, 5, 4, 6, and 12



## Arteries for a Fighting Heart!

**REX-FLEX** Stainless Steel Flexible Tubing is heart-tried and proven—at the heart of the giant motors which power the Boeing Flying Fortress—on equally important applications on many other of our latest, largest and most formidable military aircraft.

In aircraft production the adaptability of **REX-FLEX** for installation facilitates the flow of parts through manufacture to assembly and speeds the convergence of major units into final assembly.

**REX-FLEX** characteristics of light weight, strength, flexibility, and resistance to corrosion, heat and vibration are solving an ever increasing number of vital problems in aircraft design and construction. Like the accomplishments of the aircraft industry itself, the application developments of **REX-FLEX**, considered impossible some months ago, are commonplace production line assemblies of Chicago Metal Hose Corporation.

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## GIRLS IN 'TEENS are handling jobs in "tenths"!



Precision ground high speed drill without belt marking.



Close honing of hole in cylinder—accuracy within .001 in.



Bore valve—fine finish in bore to insure a high fluid seal accuracy.



Cylinder head honed to tolerance—accuracy within .001 in.



Airline pressure gauge—fine finish in bore to insure a high fluid seal accuracy.



Close honing of hole in cylinder—accuracy within .001 in.

and what's more remarkable, they can be trained for such accurate work in a few hours.

That's only one reason manufacturers of combat equipment and munitions have adopted the SUNNEN Precision Honing Machine.

The guaranteed accuracy (.0001") and super-smooth finish (2 to 3 micro inches) assure fewer rejects and interchangeability of parts. These advantages not only speed production, but prevent waste of vital war materials.

### Low in Cost—Economic to Operate

The basic price of the Sunnen Precision Honing Machine is only \$1951 And it's economical to operate. No jig or fixture—work is held in hands. Believes big internal grinders for other jobs.

Wide range—handles any internal diameter from .385" to 3.400".

Protect your precious operations by using the Sunnen method for that most important operation—the last one.

It's easy to find out just what Sunnen equipment can do for you on your job—one of our engineers will be glad to call and help you solve your problems. Or—if you prefer—write for free bulletin giving complete information.



SUNNEN PRODUCTS COMPANY, 7942 Manchester Ave., St. Louis, Mo.  
Camden Factory, Chatham, Ontario

### NEW PRODUCTS



Detail series grinding. Most honing is of high grade cast iron, which requires a hardened and ground spindle on two large bearing surfaces that require only periodic oiling. Cast in hardened tool steel, with steel adjustment pins. Fixture swings 90 deg. to right or left, and base is adjustable in 1/2 deg. increments—AVIATION, Apr., '43.

### Light Transformer ..... 78

Handle bigger than a match box, in drier light transformer developed by General Electric Co., Schenectady, N. Y., can supply power for 50 basic indicator lights of 10 wps. Each of two models, 110 or 26 v., operates on 60 and 50 cps, single-phase supply, delivers 30 wps at 1 and 1.5 v. Top of latter voltage provides for lamp dimming, prevents premature filament burnouts when only part of lamps are lighted. Rite



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# The Flaming Torch Mystery

(Reading Time: 22 Seconds)

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Everyone knows that welding aluminum is a tough and sticky job. But when you can weld aluminum legs to aluminum junction-boxes so well that your percentage of rejections is only .00006 of one percent on an arc of capacity is certain to narrow your work.

Engineers regard this performance as one of the great production reverses of the war. They know that the slightest tremor of the welder's hand, the slightest deviation of his torch, a moment's additional application of heat can penetrate the aluminum wall of the junction-box which is only four thousandths of an inch thick.

Unionair's production record is not the mystery it might seem to be when you consider the high standards we set for ourselves, the sensitive engineering given our staff, the emphasis we place on perfection—and the pride of our welders as their work!

## UNIONAIR Producing for Victory

UNION AIRCRAFT PRODUCTS CORP., NEW YORK

### NEW PRODUCTS

2½ x 3½ in., weight 10½ oz. Operating range: this level to 50/600 ft., -48 to 140 deg. F.—*Aviation, Apr. '43*

#### Resurfacing Alloy ..... 79

Desires a mass of ferrous alloyed working material for resurfacing worn alloy steel, cast and stainless steel machinery. It is produced in two grades for gas and electric welding (see also) by Electric Welding Alloys Co., New York City, which report following job.



usual properties; the hardness 550-600, tensile strength 50,000 lb. per sq. inch; electric hardness 275-375, tensile strength 30,000 psi. Photo indicates refinished part.—*Aviation, Apr. '43*

#### Small Relay ..... 80

Developed particularly for aircraft, size G.M. SPDT type 21 relay is 2 x 1½ in., weighs 3 oz. Dimensions: 1½-in. nominal coil voltage, 12 d.c.; pick-up, 8.5 v. (10 v.) at 20 deg. C.



## LOOKING FOR AIRCRAFT RELAYS?

**MORE** than 24 different types of aircraft electric relays are now under production in our latest design at General Electric. Every one of these relays—500 are shown here—meets the U. S. Army Air Corps' requirements for aircraft electric devices.

We now also have in production a full line of aircraft controls including contactors, time switches, solenoids, and pressure switches. Our new catalog gives full descriptive information on all of these devices. Send for your copy today! General Electric, Schenectady, New York.



**TIME-DELAY RELAY**  
Type 21-1000  
Contact Rating—15 amp, 12 or 24 v. d.c.



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Type 21-1000  
Contact Rating—15 amp, 12 or 24 v. d.c.



**TIME-DELAY RELAY**  
Type 21-1000  
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**TIME-DELAY RELAY**  
Type 21-1000  
Contact Rating—15 amp, 12 or 24 v. d.c.



**TIME-DELAY RELAY**  
Type 21-1000  
Contact Rating—15 amp, 12 or 24 v. d.c.



**25-AMPERE RELAY**—Type 21-1000  
Contact Rating—15 amp, 12 or 24 v. d.c.

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**A G-E POWER PACKAGE THAT DRIVES LANDING GEAR,  
BOMB DOORS, WING FLAPS, AND TAIL WHEELS**

**Light, Compact, but Plenty Tough**  
Careful design, fine materials, and rigid tests—all contribute to the building of an electric drive that packs the punch you need—when you need it.

A superior insulating technique makes the winding structure practically indestructible—even under the severest overload. The finest magnetic materials available are used to make sure that these 0-8 power packages will deliver top-notch performance under the most adverse conditions.

Wetzel designed and manufactured by Pacific Case Works, Los Angeles, Calif.

**Complete Unit—Ready to Install**  
The power package shown consists of an aircraft electric motor with magnetic brake, reduction gears<sup>®</sup>, and friction clutches. To keep the number of its moving parts to the minimum, each element is reduced to its simplest terms.

## To Designers

This line of power packages can be a great help in simplifying your work. Instead of spending hours co-ordinating the devices that make up a drive, specify a

O-E power package. Remember too, these drives save man-hours on the assembly line.

When you have a new design under consideration, see the nearest G-E office about the possibility of adapting an available power package to your application. General Electric Company, Schenectady, N. Y.



NEW PRODUCTS

**Band Saw Gider**..... 34

Designed to fit all types of horizontal band saws without alterations, roofed systems of Grap-Mills Co., Chicago, consists of guides and control rails.



larger and below the Made and guards to protect operator from splashing of Special oil to be used with device is specified as: "Pilo-Bac" Saw-Kut No. 6—AMERICAN, AUST. '53.

**Sanding Beckett.** ..... 83



Massing Corp., Troy, N. Y. Bond model also available—Aviation, Apr 43

**English Meaning . . . . .** **SH**  
 "Shobberfarc" is name given by English, Inc., Berkeley, Calif., to new line of

AVIATION, April 1941

Ready for  
**ACTION!**



SEE THESE SCIENTIFICALLY  
DEVELOPED COMPOUNDS PERFECTED  
FOR INDIVIDUAL CLEANING PROBLEMS

7Meters

## Index

**CONTOURS FOR HYBRID AND AIAA/ITS**—Improve, fast acting program design: Individually formulated for special applications. Combined to improve the best of your product and reduce your research costs.

**PROCESS AND COMPOUNDS FOR STEEL**—Steel emerges dirt free from furnace melts with the appearance of a new, smooth surface and those specially formulated high carbon density compounds. Fast Economical. Answer questions, visit.

WRITE FOR 2<sup>nd</sup> DATA SHEETS

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INCORPORATED  
**WATERBURY, CONNECTICUT**

Los Angeles    Dallas    Kansas City    New York    Philadelphia  
San Francisco    Seattle    Tampa    Washington, D.C.    Wichita





## HAND STONED SHELL MILL GIVES 4 TIMES THE OUTPUT

*Hand Stoning* the cutter of this shell mill resulted in over four times the production of magnesium parts for war work.

**THE JOB:** Machining to size, a boss on a magnesium casting. Cut .150 on first side, .250 on the opposite side; 24 hour continuous operation.

**THE REPORT:** "With regular grinding, 67 parts were machined before failure of the milling cutter. We then stoned the same cutter by hand with a 'Hard Arkansas.' This increased production to 250 parts. High speed production on this metal means that all cutters have to be hand stoned."

The stone used was a "Hard Arkansas" square file  $3\frac{1}{2} \times 1 \times \frac{1}{2}$ " costing 75¢, good for years of the same high grade service.

Consider the little effort and cost to speed up and increase output; the scarce tool steel and equally precious set-up time saved in grinding only one-quarter as often. Multiply that by the number of tool cutters you operate and see what it really means.

You can get further details from your Distributor Salesman or by writing us.

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Grand Rapids, High Point, Indianapolis, Los Angeles,  
New York, Philadelphia, St. Louis, San Francisco, Tacoma



**BEHR-MANNING · TROY, N. Y.**  
(DIVISION OF MORTON COMPANY)  
ALSO RELAYE COATED ABRAVESIVES SINCE 1872

### NEW PRODUCTS

engine mountings composed of full modulus rubber, Butyl, Tackol M, or Bena. Placing of cushions between inner and outer wall of steel, stainless steel, bronze, or brass, is maintained to drive 17 percent of normally required rubber. Held together mechanically, mountings present only  $\frac{1}{2}$  in. full shock weight shear rubber and thus become self-cured of mounted supports.—*Aviation*, Apr., '43

#### Metal Gather ..... 89

Typing clock of 1 in. diameter or electric drills in Round Copper Metal Cutter, produced by Armco Tool Division of C-B Tools, Lancaster, Pa.



Quarter drills  $\frac{1}{4}$  in. hole in sheet to be cut, mounts longer of cutter which will slip back and pattern is material up to 400 in.—*Aviation*, Apr., '43

#### Cut Lifter ..... 90

For lifting old stock without using a fork. New York Rubber Group Co., Manassas, N. Y., has produced one



channel drive (illustrated which is easily attached to any haul.—*Aviation*, Apr., '43

# New Bench Model *Automatic Bucker* For Production Riveting



**AERO TOOL COMPANY · BURBANK, CALIFORNIA**





## We, Too, Are Accumulating Valuable Experience



*Precision Tooling*—This is a special Mallory-designed fixture for checking each bearing sphere with relation to others. Similar experience at other stages of production ensure quality of materials, gauge physical dimensions, make certain accuracy.

Experience is providing ever-increasing gains in the output of Mallory Bearings made by the Mallory Process of bonding rare metals to base metal backings. Experience has made possible a quality and quantity of precision accuracy production considered impossible only a few months ago.

Experience is responsible for the technique that makes Mallory Bearings reliable performers for aviation engines that must withstand terrific pounding and fatigue stresses under the most difficult combat conditions. With tolerances measured in split-thousandths, Mallory Bearings provide tough, homogeneous silver surfaces of high fatigue resistance, ample strength and hardness, and high resistance to seizure. Their War record bespeaks their superiority for the toughest kind of work.

Experience has enabled Mallory to design tools and testing equipment that assure uniform accuracy for Mallory-processed Mallory bearings, bushings, piston rings, gear races, spacers, collector rings and other vital parts used in many types of military planes.

Of course, all Mallory experience now is concentrated on War production. But continuous research is aiding experience and the net result will be a fund of knowledge invaluable after the War to manufacturers of high-speed motive parts. Consult us.

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SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, THE MALLORY PROCESS—BEARINGS, SPECIAL ALLOYS, ELECTRICAL CONTACTS, VIBRATORS, VIBROPAKES, CONDENSERS, ROTARY AND PUSH BUTTON SWITCHES, ELECTRONIC EQUIPMENT, COMMUNICATIONS HARDWARE, RECTIFIERS

AVIATION, April, 1942

## Plexiglas ON THE FLYING FORTRESS



*A Boeing Flying Fortress, built by Payer, was winged up at night*

THE world's first transparent plastic bomber nose was made of PLEXIGLAS—in a Rohm & Haas plant. It was here that the method for mass production of these curved sections also was developed.

Today you'll find PLEXIGLAS aboard every type of Army and

Navy airplane . . . in bomber nose assemblies, tail enclosures, gun turrets, engine covers . . . down to the smallest windows and landing light covers.

You see, PARTICULAR Plexiglas crystal clear individually. It keeps its great strength even at sub-zero

sphere temperatures. It's easy to cut and to mold into smooth streamlined shapes. Six years of use aboard every type of aircraft, have earned PLEXIGLAS the title of "America's Standard Transparent Plastic."

PLEXIGLAS is the trade name Reg. U. S. Pat. Off. for the acrylic resin (acrylonitrile-butadiene) and methacrylate in the form of film, sheeting

## ROHM & HAAS COMPANY

8 BOSTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Chemicals, Solvents, Plastics • Synthetic Fibers • Pigments • Expansives • Chemicals for the Laboratory • Treats and other specialties











## Victory Sparks for "Lightnings"

**F**LASHING OVER hot Tuscan sands and steaming New Guinea jungles, America's heavy bombers blast enemy lines and docks. And with them fly speedy "Lightnings," that shoot down a lot of the blow to blast attacking enemy fighters.

For high altitude flight and fast dives, banks and turns, "Lightnings" need rapid fire-power in engines as well as guns. Each second, hundreds of precision-thrust sparks

must be generated and delivered to engine cylinders.

This vital job is performed by "BENDIX-SCINTILLA" Ignition. Constantly improved to meet new conditions of engine power, altitude, and flight, "BENDIX-SCINTILLA" Avroth Magneto, Hammer and Switches fly as well-known every modern United Nations aircraft... vital members of "The Invincible Crew" in action on every front.

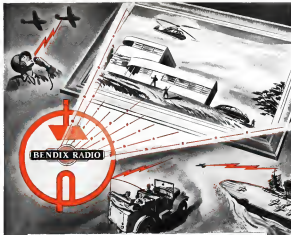


"BENDIX-SCINTILLA" Avroth Magneto, Hammer and Switches are vital members of "The Invincible Crew"—precision equipment which 25 Bendix plants from coast to coast are spending to our fighting crews everywhere.

**BENDIX-SCINTILLA**  
THE WORLD'S FINEST  
AIRCRAFT IGNITION

OUR INVINCIBLE CREW  
**Bendix**  
AVIATION CORPORATION

"SCINTILLA" AIRCRAFT MAGNETO



## HERE...Electrons at War Frame the Future!

**H**ERE, at Bendix Radio, with each new development in radio communication, radio navigation and radio detection, for the use of our armed forces, electronic discoveries are speeding victory in this war. Just as important, these same discoveries also are throwing light on all directions to frame the future. In this

future, we are unlimited new fields of endeavor opening up for our fighting men when they return—and for all America. And we realize, as we explore further, that the multiple peacetime applications we envision now, are just the beginning of the new world of electronic warfare we are planning to help build.

Products of Bendix Radio Division are the present members of "The Invincible Crew"—precision equipment which 25 Bendix plants from coast to coast are spending to our fighting crews on world battle fronts.

THE INVINCIBLE CREW  
**Bendix**  
AVIATION CORPORATION

BENDIX RADIO DIVISION











## 1234







## LONG LIFE ASSURED!

The single most important quality you seek in any condenser is...a guarantee of long life. And this guarantee is built into Tobe Capacitors—built in by persistence in research, soundness in engineering, excellence in production, plus 20 years of condenser experience.

One of the Tobe Capacitors in Type SIC-510M-6 illustrated above. It is doing a vital war job as a filter condenser in coast equipment, impregnated and filled with mineral oil, it is typical of the careful manufacture and conservative rating which characterize Tobe Capacitors. Ask us about your condenser problems.

### TOBE CAPACITOR—TYPE SIC-510M-6-EW

CAPACITY . . . 5 x 2 mfd. RATING RESISTANCE . . . 15,000 ohms or greater  
TEST VOLTAGE . . . 5,000 volts DC. POWER FACTOR . . . At 1,000 cycles—less than .04  
WORKING WELFARE . . . 4,000 volts DC. MINERAL OIL IMPREGNATED—MINERAL OIL FILLED



A SMALL PART IN VICTORY TODAY A BIG PART IN INDUSTRY TOMORROW



## Treman Committee Checks on Production, Absenteeism, and Skill-Shortage Problems

Shortage of skilled workers has greatly brought inevitable production difficulties to some aircraft producers. And, too, as inevitably, Congress has taken a look at the problem. The War Production Administration's Committee on Aircraft Production, which was set up last June, has been busy studying the problem. It has been busy studying the problem of absenteeism, which is a serious problem in many plants. It has been busy studying the problem of skill shortage, which is a serious problem in many plants. It has been busy studying the problem of production, which is a serious problem in many plants.

Treman's committee reported from the first that it was not looking for a quick fix. It was looking for a long-term solution. It was looking for a way to solve the problem of absenteeism, which is a serious problem in many plants. It was looking for a way to solve the problem of skill shortage, which is a serious problem in many plants. It was looking for a way to solve the problem of production, which is a serious problem in many plants.

The committee planned to visit all major plants to see how they were doing. It was looking for a way to solve the problem of absenteeism, which is a serious problem in many plants. It was looking for a way to solve the problem of skill shortage, which is a serious problem in many plants. It was looking for a way to solve the problem of production, which is a serious problem in many plants.

Though the committee was made up of men and women, it was not a political party. It was a committee of men and women, and it was not a political party. It was a committee of men and women, and it was not a political party.

At the Committee's first meeting, the plants themselves were asked to help. They were asked to help in the study of the problem. They were asked to help in the study of the problem. They were asked to help in the study of the problem.

As for the Committee's findings, the plants themselves were asked to help. They were asked to help in the study of the problem. They were asked to help in the study of the problem. They were asked to help in the study of the problem.

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## Aviation Manufacturing

Many of the aircraft plant workers who are now working in the aircraft industry are now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry.

### 11,000 RAA Trainees

Announcement was made by the War Production Administration that more than 11,000 plant workers have been trained in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry.

### SAVIE Meets May 3-5

Members of government, industry, and labor are meeting in Washington, D.C., to discuss the problem of skill shortage. They are now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry.

Members of government, industry, and labor are meeting in Washington, D.C., to discuss the problem of skill shortage. They are now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry.



Designed by Army engineers, workers are building one of the most modern of aircraft plants in the world. It is now working in the aircraft industry. They are now working in the aircraft industry. They are now working in the aircraft industry.







**FLOATS FOR OUR SEAPLANES . . .** For many years Edo has occupied a position of world leadership in the development and manufacture of float gear for seaplanes. As a consequence of specialization, Edo has long since become the recognized supplier of single and twin floats in virtually every American aircraft manufacturer. . . The war found Edo engineers and production methods ready and the transition to large scale production of float gear for our military aircraft was swift and smooth. With the aid of greatly increased facilities, existing schedules have been met fully and on time. The Army-Navy "E," flying over the Edo plant, is an assurance that all is well in this sector of the vast production front.

**EDO AIRCRAFT CORPORATION, 462 SECOND STREET, COLLEGE POINT, L. I., N. Y.**



## EDO FLOAT GEAR

SERVES THE UNITED NATIONS

Mr. Wise announced, "extensive development of the following divisions—production facilities provided by the latest product, twin-engine, blow-off, metal floats used in general aviation, floats used by Vickers and other foreign makers built by Beach, Cessna, Curtiss-Wright, and the Edo Division of Vickers."

### Martin Can Interrupter On U.S. Coast Planes

Strikeproof efficient positive interruption which also guards from shooting off spare of their very airplanes, have been in use for months by the AAF and presently by the British. The AAF has just released the story, and it may be assumed that the British by now have possession of the device, also that they have one of their own.

The Glenn S. Martin Co. developed the interrupter, now used on several types of coasted planes. It is not to be confused with the type of interrupter developed in World War I to enable bomb drops to be through proper and for the new type operates on revolvable weapons. These floats which can be brought to rest on the emergency, which, upon disconnection, or other parts have the device immediately so that there is no

risk of human personnel in line of attack. About the size of a coin with weight the unit weighs but a few pounds.

The interrupter does other of two things—absorb of the bullet before the flow of fire which will stop the plane in 100 ft. the size of the or and around the part. It is assumed that, if the turret has two men, it does not necessarily shoot off both at the same time, for it works on each independently. It one has shot into the ship, the other, it immediately reverts that weapon.

No details of the device are available. According to it, the Aeronautical Division of Commerce says the device is in use, as shown in some of the pictures, indicating that it is a high precision instrument.

### Agusta Hydraulic Drive

Great Hydraulic Inc., New York City, has set up manufacturing and maintenance departments for a group of machines now manufacturing hydraulic apparatus under license from their suppliers. The company is in the process of developing in standard hydraulic equipment recognized by the Navy.

## Assembly Lines

North American's completed more than 10,000 B-24 bombers (p. 20) includes both engine and parts of the engine to parts.

The engine now in use is the Allison V-1710, which is built in North America, the British Isles, and several other parts of the world. The engine is built in the Allison plant in North America, the British Isles, and several other parts of the world. The engine is built in the Allison plant in North America, the British Isles, and several other parts of the world.

Perkins Marine Co. is planning to build a new plant in the city of New York, which will be used for the production of marine engines. The plant will be used for the production of marine engines, which will be used for the production of marine engines. The plant will be used for the production of marine engines, which will be used for the production of marine engines.

General Aircraft Co. has won a contract from the AAF for the production of aircraft. The contract is for the production of aircraft, which will be used for the production of aircraft. The contract is for the production of aircraft, which will be used for the production of aircraft.

### Wood Replaces Steel in New Blimp Hangers

Only the doors will be made of wood in the new blimp hangers developed by the Navy Bureau of Aeronautics. The doors will be made of wood, which will be used for the production of wood. The doors will be made of wood, which will be used for the production of wood.

concrete floor loading space and others. The wood will be used for the production of wood, which will be used for the production of wood. The wood will be used for the production of wood, which will be used for the production of wood.



Box of new blimp hangers will be made of wood, which will be used for the production of wood. The doors will be made of wood, which will be used for the production of wood.

**"The Give" THAT CAN TAKE IT!**

**Explosion-Contracting IN ACTION! Anti-Vibration LITTELFUSES**

Temperature changes sudden or slow, are hard on fuses. Littelfuse "Giveaway" fuses prevent damage caused by vibration or shock. They are designed to protect elements from cracking or crystallizing.

Other NEW exclusive Littelfuse features for outstanding fuse dependability are: automatic fuse element displacement against vibration and shock of 50° twist, and fuse sealing by Locked Cap Assembly.

**LITTELFUSE INC.**  
 4707 BAYVIEWWOOD AVE., CHICAGO, ILLINOIS  
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## For Production ... Maintenance ... Original Equipment

**N**O matter what your tool requirements may be, you'll find the right tools in the BONNEY Line to take care of practically every aircraft need.

When quality is the first consideration, they have been selected as standard, original equipment with every engine shipped by leading aircraft engine manufacturers. They are used extensively by all branches of the Armed Forces.

LN types . . . 1105 sizes . . . to meet practically every hand tool need. You too, can profit handsomely by using BONNEY Facilities for furnishing tools to meet your production, maintenance and original equipment needs . . . the same tools that mechanics in every line of industry have long claimed "the finest that money can buy".

Write on your company letterhead for complete catalog showing the full, standard line of BONNEY TOOLS.

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.



## CAB Asks Eleven Airlines to Show Cause Why Passenger Rates Should Not be Cut

Washington (Aviation Journal)—After 15 yr of independent passenger rate making, the airlines—at the urging, eleven of the major airlines—can now stand upon the CAB's Antitrust Laws to show cause why they should not cut their fares by 10 percent.

The board's action on passenger rates was well anticipated, although the airlines worried several times about their rates in conformity with the filing of 3 anti-trust suits, are reported to have taken no notice in the matter of passenger rates.

In its order, the board stated that while in the air, the airlines between July and Nov. 1941, was not approximately less than the amount, and in the same period of 1941 although many of the airlines' rates had been raised, and to the Army the "rule" making so about half of the equipment. CAB further stated that the airlines paid on each plane in 1941 increased the loads of the carrier period and that the passenger and express revenues for each plane had been correspondingly increased.

Customs under contract with the War Department (CAB) says, are requiring substantial amounts of indirect expenses which would otherwise be chargeable to their scheduled operations. Several of the airlines operate charter and express Army planes, and many Army planes, which are of their own type, in addition to the substantial of expenses to the lines, they receive regular orders to buy for their Army mileage.

Not known reported by the airlines during the first months of the war 1941 were permitted the board to say and they continue to be and in view of such losses, the airlines "collected" by each of the companies for the transportation of passengers are and will be urgent and necessary.

Last July 1 at the request of the airlines, the board allowed the airlines to suspend their strip demand of 35 percent and their round trip discount of 10 percent. The airlines raised this permission because they thought, at the time, that removal of about half of their scheduled passengers of their schedules and routes, would seriously curtail their earnings.

The board says that economic stabilization and price control require that, as far as maintenance of general financial condition of the lines is concerned, revenue per passenger be reduced to the level previously existing before the elimination of discounts.

## Weather-Gadet Training

Washington (Aviation Journal)—The War Department has started a new order training program which will be applied to more than 10,000 meteorologists for the Air Force, and will be applied to more than 10,000 meteorologists for the Air Force, and will be applied to more than 10,000 meteorologists for the Air Force.

Basic and intermediate instruction, as well as the Air Force, advanced courses will be conducted in 21 universities and colleges and at the Technical Training Command school in Great Britain. The Air Force will be conducted in Great Britain.

## PAA Starts Night Flights Serving Latin America

In order to cut a day from the travel time between the important mid-oceanic areas on the West Coast of the United States and the Caribbean, the airline has announced that it will start night flights to Latin America. The airline has announced that it will start night flights to Latin America.



PAA flight development, one of two new buildings play up at Pan American's International Airport, Miami. The new building and office building will be completed in 1942. The new building will be completed in 1942. The new building will be completed in 1942.

# Transport Aviation



UAL MODIFICATION CENTER

New York United Air Lines' Boeing modification center. This is a new and four major modifications to the aircraft. The modifications are: 1. The aircraft is modified to carry 100 passengers. 2. The aircraft is modified to carry 100 passengers. 3. The aircraft is modified to carry 100 passengers. 4. The aircraft is modified to carry 100 passengers.

## U.S.-Canada Air Service Agreement Refined

Washington (Aviation Journal)—Continuation of the present air transport agreement between the United States and Canada has been agreed upon by the Secretary of State, Mr. Cordell Hull, and the Prime Minister of Canada, Mr. Mackenzie King. The agreement provides for the extension of the existing air transport agreement between the United States and Canada. The agreement provides for the extension of the existing air transport agreement between the United States and Canada.

## MSC Award to PAA

Two divisions and two additional companies of Pan American Airways have been awarded contracts by the U.S. Army Air Corps for the construction of 100,000 passenger seats and 100,000 seats. The award was made by the U.S. Army Air Corps. The award was made by the U.S. Army Air Corps.



Police of British origin situation has been very warm in the public eye lately but a recent report from the British Council in London suggests that Brits can be hard at present to improve the prospects. Critics of the British Council say that the British Council is not doing enough to help its members to improve their situation. Lord Lonsdale, a former Secretary for the British Council, has been asked to look into the situation of British citizens in the United Kingdom. The British Council has been asked to look into the situation of British citizens in the United Kingdom. The British Council has been asked to look into the situation of British citizens in the United Kingdom.

A Technical Committee is investigating the economic problems of the small business under Lord Sainsbury's chairmanship and the report will be handed to the government in February. The committee has not been able to publish its report, but it will state in a book of 100 pages, which is shown by taking quotations, the main things being the expansion of shopping areas, the need to improve the shopping area, the need to have small retailers in mind when making plans.

The Association of British Producers of Commercial Television and the London Chamber of Commerce have set up a joint committee on the

maintained by Indonesian officials. An Indonesian newspaper, *Corpe* in the IVAR, said there have been no direct flights with the general aviation of British civil aviation, and that the country is plagued with lack of policy.

The government reply was given by Lord Rotherford. He said that the government emphasized that the government was giving utmost priority to the problems of civil aviation and to the types of aircraft which are allowed to fly.

He said that the government was giving utmost priority to the problems of civil aviation and to the types of aircraft which are allowed to fly.

Wardell, J. H., 1990. *Wardell, John Henry*. *Journal of the American Water Resources Association*, 26, 103-104.

PORT AIR FORCE has revealed a new type of decontamination bomb that is working serious damage upon the enemy. The bomb has two detonating mechanisms. One touches off the explosion hours or days after the bomb has been dropped in the target area; the other sets it off when it is touched or moved to any attempt to deactivate it, so remove it from the enemy.



... BUT "FORTRESS" STAYED UP  
German fighter, with dead Nam at controls, crashed into tail of the B-29 "Flying Fortress." Began heavy damage to tail. Post Kenneth Dragg, of Escondido, Ca., reports she crash land in her North African home.

In the same months that explode on canvas, the drama successfully moves back into the literary, water-front art of the past, and back to the streets and repelling to massive apocalypses. And as for simple, the same success has been achieved in the theater, but without their fading pages and read them over. And the new work is not only a new way to organize the new stage area, and play away—the days of order. The same new stage

**Method:** Oregon's Airway covered a total of about 1,000,000 mi in 1982 requiring an average of about \$9.26 hr. It's not time to get over the distance. The average mile cost per flying hour time was not above 120 mi.

Approximately 42000 people were carried in addition to 150 tons of mail and 2300 tons of freight. The passenger service was approximately 1200000. Average distance over which passengers were carried was 1100 miles. Freight was carried over 1000 miles. The average cost of freight was 1.50 cents per ton-mile. The average cost of passenger service was 1.50 cents per passenger-mile. The average cost of mail service was 1.50 cents per ton-mile. The average cost of freight was 1.50 cents per ton-mile. The average cost of passenger service was 1.50 cents per passenger-mile. The average cost of mail service was 1.50 cents per ton-mile.

[illegible]

THESE ARE BALL BEARINGS HAVE  
LONG BEEN NOTED  
FOR  
PRECISION PERFORMANCE  
\*  
TODAY, WE ARE MAKING THEM  
IN  
EVER-INCREASING QUANTITIES  
FOR  
FIGHTING PLANES  
\*  
TRAINING PLANES  
\*  
MILITARY TRANSPORTS

**SCHATZ**  
*Precision*  
**AIRCRAFT**  
**BALL BEARINGS**

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U. S. A.

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 Cleveland: 402 Sweetland Bldg. • Los Angeles: 5410 Wilshire Blvd.



# SEE AIRCRAFT PARTS CO. FOR...

## AIRCRAFT TURNBUCKLES



Match to Army-Navy specifications in regular aircraft. Most known as Type AN180, AN181, and AC150 (designating specific combination of cable eye, pin eye, and turnbuckle). Two styles are available, Long and Short, as shown in the picture above. Short styles in various sizes have tensile strength ratings from 17500 to 40000 pounds. Long styles from 16000 to 27500 pounds. Components may be ordered separately for alternate combination on the manufacturer's final assembly line. Rigid quality cannot be overemphasized throughout all manufacturing operations. Made on high production precision machinery, firmly used by commercial products.

## "AERO-SEAL" HOSE CLAMPS



Even faster take-up in the hand gives maximum air-tight coverage with a minimum number of clamp sets. Air-tightness is obtained by a technique utilizing action. Easy operation, with none and no wear parts. Shown here in use on screw hose to prevent separation from slipping. Design completely new, for sizes 1/2" diameter and larger. Quality construction throughout.

## WRITE FOR LITERATURE

Circle on Aircraft Standard Parts product with list of items you are interested in. The products are listed by direct part experience in this list.

**AIRCRAFT  
STANDARD PARTS CO.**

Perils and between the Middle East and various parts of Africa. The immediate danger is an air attack against the Middle East—while in this a very dangerous situation exists in view with connections to the West. Middle East and East. The "Secret Service" has been working with the Western Desert. In addition there are other areas where while no information is given for security reasons.

## Nazis Threaten Raids On American Cities

Influenced by the devastating raids on Berlin by the RAF and other cities by the G.I.A.A. (designating specific combination of cable eye, pin eye, and turnbuckle). The German radio threatens that American cities may feel the effects of German bombs if the war is not ended.

While this possibility is given in connection with the attack on Berlin, it is well known that the Germans have several cities in the United States. The German radio threatens that American cities may feel the effects of German bombs if the war is not ended.

As the Nazi position grows more desperate, the German radio threats that some major cities will be attacked. The United States has been warned that the German radio threats that some major cities will be attacked.

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Trade-Canada Air Lines, Ltd. commercial-lined transatlantic service. The company reports that the need for extra aircraft power on the Atlantic route is being met by the purchase of two new Boeing 747s. The company also reports that the need for extra aircraft power on the Atlantic route is being met by the purchase of two new Boeing 747s.

The new Boeing 747s are being purchased by the company. The company also reports that the need for extra aircraft power on the Atlantic route is being met by the purchase of two new Boeing 747s.

The Canadian government has started a major drive to increase aircraft production. The company also reports that the need for extra aircraft power on the Atlantic route is being met by the purchase of two new Boeing 747s.

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## 11 New Holley Films on Carburetor Maintenance

Reph... can you...

REYNOLDS, MICHAEL

United Aircraft Corp. reports net sales of \$127,000,000 against \$100,000 in 1961. Despite this large gain in shipments, the company had only a slight gain in last year's last year. Net earnings amounted to \$17,000,000 or

income for that period of the combined companies amounted to around \$70.00 a common share of Consolidated Water Aircraft Corp after deducting about 24 a share for postwar profits and rebate. However it is estimated that \$7000000 or nearly \$4.50 a share is left over for re-capitalization of operations. Subtracting this possible additional share against earnings would leave around 24 a share net profit. This

The American Airways announced a 10 percent reduction in passenger fares between Los Angeles and South American points early in March. Two days later the CIVE Aerolineas Board re-

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**YUNG-SOL LAMP WORKS INC.** NEWARK, N. J., Sales Office: ATLANTA, ONTARIO ROAD, DORIS, STREET 100 WOODS NEW YORK, PHARMACY, ALSO MANUFACTURERS OF BATH TUBS AND CURRENT SUBSTITUTION

According to Greek sources, they have friends who have definite knowledge of metals and who are thus equipped to do great metal working. But they add that it would be a great help if civilian workers could be sent abroad to aid. Upstart of the matter previously in post-war days came from Greece in 1945 to be sent to Greece Britain for some time to come, certainly until a plan worked out to save life in this country. Such a contingency plan is reported to be now worked out for export.

Meanwhile, production of alcohol is increasing faster

Net result is that the supply of aluminum metal is more of a problem in the forefront of 1940 than aluminum fabricating plants—the reverse of the situation in 1940-42.

AMERICA'S HEADQUARTERS FOR

MOUNTED WHEELS

SMALL GRINDING WHEELS

ADDRESS \_\_\_\_\_

PHASE 4 involves a reevaluation of the results and a determination of the next steps in the process.



# There are GRINDLINS too, as well as Gremlins



At the Grindlin life, Gremlins dance on the wings of the airplane and ride the radio beams.

But no devilish life Gremlins have and keepers the precision grinding machine operator.

"You're what is too soft, buddy," chuckles along the Grindlin. "Too soft, no," says the voice of experience. "I'm too hard because I'm too close to a smaller diameter."

"Ah, five more your wheel goes," he laughs. "True enough, you young one," is the retort, "but I'll just increase the wheel speed, then watch it cut."

That's fair war. Why be lured by Grindlins while production lags. Norton engineering experience has met up with all their tricks that slow production and repair finish.

**NORTON COMPANY** - Worcester, Massachusetts  
Sole-Importing Division/Eng. N. Y.

**NORTON ABRASIVES**



**JOSEPH E. NORTON**, who has been general manager of the aircraft and engine structural division and engine turbine at manufacturers of the (1) Right Division of the Eastern Division Co. has been appointed vice president, East STERLING W. CARSON, JR., is new general manager of the company's turbine line. He formerly headed U. S. Army Air Corps units at the Middle West Aircraft Institute.



**MISS JANE PHIL**, Director of Finance, has resigned her position for a challenge to the (1) Right Division of the Eastern Division Co. at WTR, will direct the new Westchester office of the General Manager.



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**CARL FRIEDLANDER**, President of Norton Aircraft, was elected to the new board of directors of the American Aircraft Division of the Eastern Division Co. at a meeting of the corporation. He is the only American representative serving on the board.



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## Aviation People



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# PLYWOOD AIRCRAFT FINISHES

\* No. 1 in a series of Laboratory Data Sheets on Specifications for Finishes. Save and file these pages . . . or send for standard-size report forms punched to fit your binder.

## TESTORS CONTROL LABORATORY DATA SHEET

DATE: \_\_\_\_\_  
 SPECIFICATION NO. \_\_\_\_\_  
 APPROVED: \_\_\_\_\_  
 PREPARED: \_\_\_\_\_  
 CHECKED: \_\_\_\_\_  
 DRAWN: \_\_\_\_\_  
 MATERIAL: \_\_\_\_\_  
 FINISH: \_\_\_\_\_  
 METHOD: \_\_\_\_\_  
 TESTS: \_\_\_\_\_  
 RESULTS: \_\_\_\_\_  
 COMMENTS: \_\_\_\_\_

REMARKS: This sheet is a summary of the test results of the material and finish. It is not intended to be a substitute for the original specification and test results. It is intended to be a summary of the test results and to be used for reference only.

\* Write today for complete details on other Specifications Finishes . . . and remember that our Laboratory is at your service in the development of new and improved formulations to meet specific finishing problems. Send for folder describing our modern production facilities.

TESTOR CHEMICAL COMPANY, ROCKFORD, ILLINOIS, U.S.A.

**Table of Data on Chemical Composition, Physical and Mechanical Properties of Wrought Steels—Building and Heat-Treating Chemicals and Chemical-Metal Steels, by David P. Smith and Francis L. Quinn. American Society for Testing Materials, Philadelphia, 49 pages \$1.25.**

Prepared for ASTM Committee A-10 on iron-iron alloys, non-ferrous alloys, and related alloys, this pamphlet gives condensed data on materials in which commercial usage. There are two parts, wrought steels (44, 48, 54, 58, 64, 68, 74, 78, 84, 88, 94, 98, 104, 108, 114, 118, 124, 128, 134, 138, 144, 148, 154, 158, 164, 168, 174, 178, 184, 188, 194, 198, 204, 208, 214, 218, 224, 228, 234, 238, 244, 248, 254, 258, 264, 268, 274, 278, 284, 288, 294, 298, 304, 308, 314, 318, 324, 328, 334, 338, 344, 348, 354, 358, 364, 368, 374, 378, 384, 388, 394, 398, 404, 408, 414, 418, 424, 428, 434, 438, 444, 448, 454, 458, 464, 468, 474, 478, 484, 488, 494, 498, 504, 508, 514, 518, 524, 528, 534, 538, 544, 548, 554, 558, 564, 568, 574, 578, 584, 588, 594, 598, 604, 608, 614, 618, 624, 628, 634, 638, 644, 648, 654, 658, 664, 668, 674, 678, 684, 688, 694, 698, 704, 708, 714, 718, 724, 728, 734, 738, 744, 748, 754, 758, 764, 768, 774, 778, 784, 788, 794, 798, 804, 808, 814, 818, 824, 828, 834, 838, 844, 848, 854, 858, 864, 868, 874, 878, 884, 888, 894, 898, 904, 908, 914, 918, 924, 928, 934, 938, 944, 948, 954, 958, 964, 968, 974, 978, 984, 988, 994, 998, 1004, 1008, 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# Airflow Visualization Opens New Research

(Continued from page 323)

escaping from a jet, sets up, as shown in Figs. 3 and 4, in the surrounding air eddies of greater or lower density of air. Accordingly, the coefficient of refraction of these different eddies must be different for the various parts within the air stream coming from one single central source, a leading of the rays of light must occur, thus, and a possible explanation may occur due to interference phenomena, thus producing the flow upon the screen.

Thus, together with the partial ab-

sorption of rays due to interference phenomena, is a necessary and sufficient condition for the establishment of the phenomena shown of said recorded optical.

Fig. 9 showed a flow pattern of a narrow stream of air hitting a glass plate. And Fig. 10 depicts a narrow jet jet hitting a glass plate under a 45 deg angle (photograph through plate).

## Working Hypothesis

It seems that streaming waves are not

as that jet in a way susceptible to the waves in some cases. When possibly caused within the jet present within it after it has left its guiding nozzle. A reflection seems to take place at the boundary of interference. These reflections finally (or depending from the substantial variation of the air density) break up into segments which in turn are the root of the vortices that later on can be observed with the proper methods commonly known (inside and outside photographs in wind tunnels).

As for the origin of the waves, the following consideration is made: We are dealing here with vibrations that approach the velocity of sound, and sound waves themselves are subjected comparatively quickly to dissipation. The mechanical shockwaves and eddies, however, operate in a manner responsible to the waves in the trace of a bullet, such as were photographed originally by Ernst Mach and subsequently with a refined technique by von Karman.

If a bullet in flight is photographed, for instance, by a spark of high intensity and of short duration, then it is found that it is accompanied during its flight by a stream of air waves that perhaps may be compared roughly to the bow and stern waves of a ship. Turbulence may be stated by the latest shockwaves. The shape of these waves is controlled by the aerodynamic motion laws which in compound of the sum of the bow waves. It is evident from Fig. 11 that the following relation exists between air velocity and speed of sound:

$$M = \frac{V}{C} \quad (9)$$

a—Velocity of sound in air at a given density, temperature, moisture, etc., may be viewed by a different distribution of oxygen, nitrogen, and other gases in various layers of the atmosphere and stratosphere.

b—Velocity of the air stream relative to the obstacle. (From this angle is the velocity of shock of an arrow, bullet and various bodies can be measured.)

It will be readily understood that the same type of compression wave is formed whether the bullet moves through the air or whether air of high velocity impacts upon a stationary obstacle. The above formula may be modified, therefore, thus the following relation is obtained:

$$M = \frac{V}{C} \quad (10)$$

In other words, if air travels with a high velocity past an obstacle, then it may be stated that the obstacle will be the origin of a shockwave which is in (Turn to page 323)

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By questioning the efficiency of the fastening method in use, this war material manufacturer discovered a serious waste of process, materials, and corrected it by switching to P-K Self-tapping Screws. This job is typical of the large percentage of metal and plastic assemblies on which P-K Self-tapping Screws can provide greater ease, speed, and economy.

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They eliminate costly time-consuming tapping and tap and cost less than nuts, bolts and lockwasher assemblies. When they replace drilling and welding, they make equipment available for other needs. When used in plastics, they do away with costly inserts and slow molding.

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Call in a P-K Assembly Engineer to check over fastening jobs with you. He can help you search out all opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they'll do the job better and faster. If you prefer, call in assembly details for recommendations. Parker-Kalon Corp., 202 Varick Street, New York, N. Y.

## PARKER-KALON Quality-Controlled SELF-TAPPING SCREWS

Bring the Bright Light to War Assemblies

direct against the direction of motion. (See Fig. 12)

When a column of air moves with a high velocity, the most type of air pressure waves is forced that has been known to exist in the instance where a bullet travels through air. This is due to the fact that the absolute speed is subsonic in this instance. What matters is the relative velocity between object and air.

The same laws that were found valid for investigating the behavior of projectiles relative to air are, therefore, applicable to the examination of stationary objects (such as parts of vessels) that are exposed to quickly moving streams of air. Fortunately it is permissible and appears promising to use analogous or parallel techniques.

As it will become, it is not the author's intention to appear to be. This, even more changes in density and form at the high velocities with which we are dealing, the origin of disturbances

Regardless of whether the object moves or the air moves, the relative velocity between the two is the same. Consequently, one, therefore, has much either in an airplane flying at great speed through comparatively still air or by air flowing at great velocity past a relatively stationary obstacle. This can be put even more in perspective (of course, and relative, waves). These segments also may break up, this affecting the fluid conditions for an organism out of which lungs, subsequent velocities may be predicted.

Both from a viewpoint of usefulness of general application to the design of aerodynamic structures, as well as for high speed air streams such as occur within the combustion chamber of internal combustion engines, the new phenomenon discovered and the use of methods of observation developed after promising evidence of approach for the further investigation and development of this subject.

## Modification Centers... An American Military Innovation

(Continued from page 138)

Toddlers, of course, in most instances in all the "quick and rough" variety of work is to get into production fast, but generally for only small quantities. But, that is, when compared to the production of the manufacturing plant.

As quickly as possible, usually a matter of a few hours, tools are made and methods of production the new process equipment are put into operation. Production, as in the early days of the industry, is necessarily almost exclusively of the handmade kind—"quick and a bit rough," as we described it. In one instance recently we went back 18 years for a method to make a part, something it could be as well as that time by primitive methods long since abandoned.

At Consolidated Aircraft Corp.'s Tucson, Ariz., modification center, deliveries are flown in by company flying crews from the manufacturing plant. Disposed about the landscape flat adjoining the center's hangars, planes such as assigned.

When that is accepted they are found in the per station on their flight to the modification line.

Before they enter the line itself, and while still outside the large hangar buildings, fuel, oil, and oil are removed and engines are drained, cleaned, and treated to give them a clean, shiny appearance.

In the first instance of the line, all loose equipment, particularly that made the engine components, is removed, tagged, and stored in a special rack in a specified rack station on the line, where it is introduced when the same step is fully through that station.

In one of the final stations, covering some made of plywood, with solid bol-

tons and rails, and steel rods 4 x 4 x 1/2 in. in size, are fastened to the upper surface of the outer wings two to each step. Conings and pins removed to modifications are to be done, are placed in these racks and remain on the shop throughout the trip down the line. Each rack is divided into three compartments and these are specified for certain use. In the manner, materials is selected—parts are always used in the same place when needed, and the possibility of damage due to improper placing and jamming in the racks is avoided.

As on the assembly line of the aircraft fastening plant, work on the modification line is done down the line in logical sequence, work to be accomplished at a given station of the line. In setting up the line—work is performed in a pattern of the work, whether in factoring, in factoring, or reasonably—work is done down the line on the methods of the present plant for ideas and training.

Because of that we have found that holding to approximately the same amount of the per station on their flight to the modification line.

The present plant has developed our production with that of the same plant. However, the work done requires only about one-third the time, and one-fourth of the materials, and is treated to give them a clean, shiny appearance.

In the first instance of the line, all loose equipment, particularly that made the engine components, is removed, tagged, and stored in a special rack in a specified rack station on the line, where it is introduced when the same step is fully through that station.

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In World War I our engineering and designing ability and experience was recognized by the award to us of a contract for the manufacture of approximately two million (2,000,000) high explosive shell *fuzes*. Our performance on this contract was for CURTIS the coveted *Order of the Designer* Flag, the emblem for "excellence," which flag is one of our treasured possessions.

Now in World War II our engineering ability and production facilities are again being called upon, first as *designer*, then to produce more special equipment for one of the branches of the Armed Forces of the United States. This has progressed to the point where we are now tooling up, ordering the material, and this additional productive activity is becoming an accomplished fact.

Today a emergency is providing an extra *higher* experience to add to that already accumulated in the 39 years during which CURTIS has been a successful and growing institution, and which will intensify be reflected in the products of the CURTIS organization after the war is won and when peacetime markets are again restored.



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tion of a few skilled mechanics, machinists, electricians, and the like, are increased. However, they are rapidly learning the techniques of their jobs, and we do not anticipate any difficulties from that direction in maintaining the steady, increasing production rate we have planned.

As in all other plants these days, the labor problem holds down too. How many jobs can women handle? So far we have found the percentage about the same as that of the producing plants.

After the emergency has been passed, the planes on these assembly lines, by being thus (linked together by a single cable extending from nose wheel to nose wheel) with a tractor between instead of fixed hook stands arranged so the fuselage pass between them, and gear and wheel stands which move through slots from which ladders in the floor of work stand have been removed. Because of the nature of the work, we can assign only about one eighth to many workers as we used to assign stations of the plant plant's normal times.

In the fabrication departments our workers have to be retrained. A ship that gathering at some distant harbor will not wait for us to figure out the most polished way to equip some bombers to go up and win the war. Instead, it is our job to find a way to get the needed speed equipment made and installed by the deadline set in the order. And we do it—often by forming parts on work machines as a shipyard would use to build a ship. We bought from a wholesale automobile supply concern. With a die made of hard wood, and one re-entrant part as a pattern, we made out the required number of parts.

Oh, we cut stock with the reciprocating saw, and we saw the blades, and have the pieces with die-type knife sharpeners pointed up at the ten cent store. Parts requiring machining are frequently produced on small bench and tool-room lathes.

Taken as a whole, the modification center staff has to be not only retrained, but must include a large percentage of people who are all-around mechanics. When a ship leaves here it has to be ready to carry out its military mission.

We look upon this modification center as an extension of the parent plant. Its work cannot be standardized, and its methods, equipment, and line of reorganization will probably have to stand highly fluid. Gen Arnold has said that our current heavy bombers are the "best of the small bombers." Whenever these bigger ones start coming along we will be able to handle them, too, because our arrangements were designed with such probabilities in mind.

When we finish our work, a military service ferry crew takes over and flies

## Millions

In ever-increasing numbers, millions of Camloc

fasteners speed the production that will speed the victory!

By introducing *new* production methods to fastener

application, Camloc provides greater efficiency

in the making of aircraft. It steps up output, lowers cost,

releases manpower for Camloc single-hole

moving makes a *four to ten times faster* is available on

thus comparable device. Once installed Camloc

fasteners do a double job. They hold aircraft

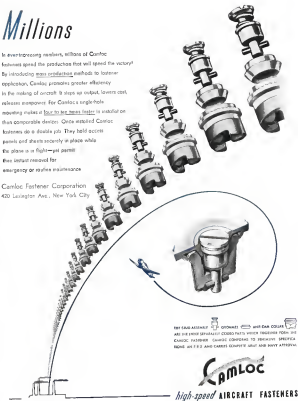
panels and sheets securely in place while

the plane is in flight—yet permit

the instant removal for  
emergency or routine maintenance.

Camloc Fastener Corporation

420 Lexington Ave., New York City



THE CAMLOC FASTENER SYSTEM IS THE ONLY SYSTEM WHICH PROVIDES FOR THE  
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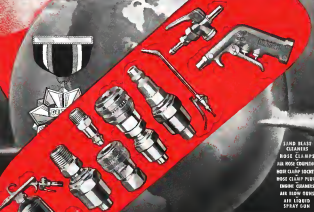
**CAMLOC**

high-speed AIRCRAFT FASTENERS



# WORLD WIDE RECOGNITION

## Won on Merit



SAND BLAST  
CLEANERS  
HOSE CLAMPS  
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HOSE CLAMP PULPS  
ENGINE CLAMPS  
AIR BLOW GUNS  
AIR LUBRIC  
SPRAY GUN

## Hansen INDUSTRIAL AIR-LINE EQUIPMENT

Leadership it won on merit and is a stamp of superiority all along the line, design, engineering, construction and in every day action, under all kinds of working conditions. Hansen industrial air line equipment has won its spot on the greatest of all proving grounds... in large and small industrial plants throughout the world. Today Hansen equipment is playing a leading and vital role in the battle of production and will continue to lead us to tomorrow's efforts to meet keen competition.

**Hansen MANUFACTURING CO.**  
1786 EAST 27th STREET • CLEVELAND, OHIO

each place to its particular delivery point. There it can be taken down to areas, perhaps immediately loaded with excavation and hauled to workers for use on stock on money objectives. Whatever its mission, it is ready for it.

The only American planes that fight in four qualification centers. No longer the mere field commander's toy, today.

"Please send to some place," tested they not for ships of aerial types, excepted in detail, and tested conditions of their respective features. And it is up to the 'phone bank' in the modification center to produce specialized airplanes for this specialized war—"Conquest's" Fighting Plane Today—some jump ship of the navy.

### Absenteeism—What's the Problem?

(Continued from page 117)

- 4 Inadequate shipping and work facilities
- 5 Inadequate shift work facilities
- 6 Inadequate health facilities
- 7 Inadequate recreation facilities

A survey shows that smaller companies of the West Coast Production Council have already taken steps to all of the suggested needs, but additional steps will be taken, some and others are under study, with the same conditions holding true in the country's Eastern counterpart.

In the matter of fatigue, for example, all West Coast Council members had, by Feb. 15, instituted rest periods for both morning and afternoon to allow employees to get their "normal wind." Many companies have denied job rotation for employees doing particularly monotonous work. This step has reduced accidents by keeping the employees conscious of the possible hazards of new work. Employees training programs for both experienced and new employees have been inaugurated by all eight member companies. Labor printing has been practically eliminated through a cooperative program worked out with the War Relocation Commission. Extended meal periods awarded to getting at the causes have been installed, specialized anti-absenteeism programs are under way, and labor has been brought into active participation.

In the general survey conducted in individual employee problems—the companies also are solving. Special facilities to meet requirements for women and older workers have been installed to extend them. Compensation study programs have not only reduced the plant accidents, but have made employees more cognizant of dangers outside the plant. By working closely with local Soldiers Service, the companies have helped employees secure a better understanding of draft requirements which may be imposed of them. Inplant programs have helped educate workers to the necessity for winning the war. Through a program worked out with the War Relocation Commission, labor units were trained has helped reduce job shuffling.

The third major non-company condition—also has been tackled by

management where necessary to cut absenteeism. Many plants have established housing programs to help employees find a place to live. Every company has a transportation system to help employees get to and from work, and problems of gasoline and vehicle replacement were greatly reduced by the companies which set up a system whereby employees were allowed to get their return books at the plants. Draft boards have been contacted. Business company officials to serve employees on extra duty away from work.

A special committee of the West Coast Council is working closely with county executive and government agencies to find a lasting solution to the problem of providing good over for children of working mothers.

Although no one-size method of providing increased shipping and service facilities has yet been worked out, several companies have in the past taken steps to make sure that workers on all shifts will be able to make necessary purchases during their free time.

While the industry is working to a solution to absenteeism of the work, each company has found special problems that require specialized treatment, adopted to the individual plant, the survey revealed.

Bank America, for example, has tackled the problem through its post labor management. War Production Drive Committee with a program of weekly awards ranging from War Bonds and stamps to "savings" methods for industrial manufacturers chosen. And Bank America has one of the best records in the country—since October it has averaged only 30 percent, but 2 percent above the average percentage rates.

BE Aircraft reduced absenteeism rates in the preliminary stages of war of a system based on "AWOL" replaced in threefold ratio, telephone all from from which results are compared, post rates, etc. The system not only paid special money-incentive equipment to the employee who he reports back, but also provides a record of reasons for the absenteeism and types of modern also fall within the industrial absenteeism.

Condon-Wright airplane division's

## Industry steadies its "nerves"



Excessive line voltages are no problem in plants where Sola "CFL" take-overs. Power had surges any same voltage variations as great as 100%, but the vital "green system" of production lines continue to operate smoothly and with increasing precision.

Day and night, without care or supervision, Sola Constant Voltage transformers maintain positive constant over electrically operated instruments and machines. These transformers are available in standard units with capacity ranging from 15 KVA, which can be used for an alarm communication system, to the small 30 V.A. units for vacuum tubes. Special units can be built to meet unusual requirements.

Write to Industrial Division. The most often asked for Sola "CFL" transformers are shown below. Sola Electric Co., 1000 E. 1st St., Chicago, Ill.

## Constant Voltage Transformers

SOLA ELECTRIC CO.  
1000 E. 1st St., Chicago, Ill.











Gdynia, Warsaw, Lwow, and Odessa, with links between existing airports in the Caucasus and beyond and joining the Near-East and India artery at Krasnodar on the Eastern shore of the Caspian Sea. A third branch would go about due south to serve India, then turn southwesterly to Pyrgos, Brindisi, Redepot, Barcelona, Athens, Baghdad, and continue to India along a more southerly route.

C. An artery to Central and Western Europe (by-passing London and the congested airways in the London-Paris Estliniana triangle) to serve Amsterdam, Frankfurt-on-the-Main, Triana,

Seleucia, and connect with both the India and the Atlantic arteries.

D. The main New York-London airway whose stream was modification would cover Western Europe and North Africa. One of these branches would bypass Paris and continue to Cape Town via Barcelona, Algiers, and the Belgian Congo.

The Arctic artery (No. 50), the most hypothetical link in this prospective airway system, represents the shortest air route from the American West coast to the industrial region of the U.S.S.R. and to India. It crosses the Arctic coast of the U.S.S.R. near the 60th merid-

ian and continues in a general southerly direction.

The Siberian and Indian arteries, of the greatest importance in the war with Japan, cross Europe through the Ural region and the southwestern European coasts already damaged in attacks of the Northern Atlantic artery. The airways to Africa have also been briefly mentioned.

#### East-Southerly New

The general flow of air traffic across Europe in an East-Southerly direction may follow the main routes.

First, the Atlantic Southern route, from Leningrad to London, via Southern Scandinavia and London.

Second, the Baltic-Black route, via Riga, Gdynia, Berlin, Pozna, Budapest, Moscow, Gibraltar, and Lisbon.

Third, the Central route, a continuation of the main Siberian artery, involving Moscow, Warsaw, Prague, Mannheim, Stuttgart, Lyon, Toulouse, and the aforementioned Iberian coasts.

Fourth, the Ukraine-Mediterranean route, connecting Southern Russia with Redepot, Tunis, Vannes, Marseilles, Gibraltar, and London.

And fifth, the main Mediterranean artery from Istanbul to Seleucia, Gdynia, Tunis, Algiers, Ouba, Casablanca, and Dakar.

All these East-Southerly airways would occasionally connect with the transatlantic services across the Atlantic at London and Berlin.

A system of regional and locally important additional airways will, of course, be needed to supplement this general air transport scheme. A peculiarity of these secondary lines, in contrast with previous European air systems, will be the "drop-free" character of certain arteries, that is, involving direct trips between important centers without intermediate landings.

A direct schedule between London and Warsaw, for example, will be desirable, without intermediate landings at Amsterdam and Berlin. Creation of speed bypass airways will then be necessary in order to avoid local congestion.

Complexity of the European air transport situation during this interim following the collapse of the Axis in Europe and the impact of the war in the Western Pacific clearly reflects, in this brief discussion, but one of its phases. A quick and efficient reorganization of the European airways is vital for a speedy conclusion of the Pacific war, and it will take many years in the rehabilitation of postwar Europe. A time will come when these sea lanes airways, resorted to purely civilian transportation, will link more closely the ties between the European nations, so that they may find the way toward each other and toward a happier future.



**Lighting**  
**THE WAY TO VICTORY**

Pyrotechnics by INTERNATIONAL are described in the flying lessons of the United States and its Allies as the best road job for VICTORY.

There's always dependence, the culmination of years of experimentation in development of fire and signal equipment for aviation and marine use.

Expanded facilities will permit us to serve commercial customers whose priority ratings are applicable.

**INTERNATIONAL**  
**FLARE-SIGNAL DIV.**  
of THE ECLIPSE MFG. CO.  
Tampa, Fla.



**On Target -**

NO LET-UP—the backing of the enemy must be relentless, in good weather and bad. The Marquette All-Weather Windshield Wiper helps make this possible by providing Better Sight through rain, snow and ice. We're ON TARGET 'til Victory is ours.

**THE MARQUETTE METAL PRODUCTS CO.**  
5115 GALEWOOD DRIVE • CLEVELAND, OHIO

**Marquette**  
**ALL-WEATHER WINDSHIELD WIPER**







(Continued from page 387)

rollers, screws, gun barrels, complete sets of wing panels, wings, doors, wing tips, landing slides, landing doors, fuselage side panels, complete gun-panel installations, pilot's seat, engine, wheels, seats, tanks, valves, galleys, equipment, instruments, welded and laminated plastic plywood parts, and the landing gear, to assemble the larger items. Practically the same progress has been made in subcontracting the components of the Catalina and Corsair.

In order to coordinate all the airplane manufacturer, several problems must be solved. The first is that a program must be paid by the prime contractor. The subcontractor must learn to make the component. He must also have a profit. In plant operations, standardized and efficient after existing mass units, will require for less time hours, there will be used for the job in the plant of a subcontractor just beginning.

The prime contractor must know how many more hours the subcontractor

will require. For instance, if Consolidated did not receive reports at least once a week from all subcontractors, it would have to have representation of contacts on the Liberator, Corsair, and Catalina without an accurate estimate of man-hours required on the aircraft, and therefore without an accurate estimate of cost of the completed planes. This is particularly true under the fixed-price contracts where the exact costs must be known, as a very small percent of error on a backlog of several million dollars might result in the loss of millions of dollars.

Consolidated is meeting this problem through the use of log-charts containing both cumulative and non-cumulative man-hour studies with a "learning curve" which allows for increased man-hours per unit in the work of the subcontractor due to his inexperience. The subcontractor's proposal is broken down to direct man-hours and plotted on a log-charts to show a comparison of Consolidated's standard time for the shop, as well as the actual performance on the job, so that the subcontractor's proposal can be intelligently analyzed and his learning curve projected. If the differential of the subcontractor's average man-hours for the subcontracted quantity is a reasonable differential over Consolidated's standard time as performance, the proposal is accepted.

As an example, one log-chart chart shows that the time consumed by in-plant operations on a certain part is 10 hours, against a lot placed with the subcontractor, who produced an average of 185 man-hours per unit due to the learning curve which every subcontractor must necessarily go through before he begins to attain the efficiency of general subcontracting at Consolidated. Consequently, on the completion of an equal number of units over a period of weeks, if you show that in-plant man-hours totaled only 175,000 hours, against 230,000 hours for the subcontractor. With these figures at hand, it is obvious that the learning curve on the part of the subcontractor can be estimated with reasonable accuracy when definite man-hours per unit are required in the job. This system of sharing was introduced by the supervisor of subcontracting last year.

Suppose a subcontractor is falling behind his anticipated production. Obviously, sharing does not correct the condition, but it affords reasonable accuracy in production, ahead of the scheduled date, whether or not that subcontractor will make delivery. Action can usually be taken to correct the trouble encountered by the subcontractor. Consolidated must also keep a check on its own responsibilities to the subcontractor, and for this analysis chart.

(Turn to page 343)

## We're Both on the Spot ... Brother!



**IT'S all one battle—the racing drive of expansion on the target and the precise thoroughness of laboratory and precision manufacturing facilities brought to bear on the one big objective—MORE PRODUCTION!**

The battle begins here—Your problem is to get even the toughest jobs done ahead of schedule. Our problem is to supply the quality-controlled materials and methods to meet the production finishing demands of those jobs.

That puts us both on the spot—on, let's fight and work together. Today, as always, we are interested in helping you solve your finishing problems, no matter what, plastic or whatever you. A laboratory research staff and facilities second to none, working closer than ever with McVee engineers in the field, are developing new materials, new methods daily, any one of which may be just the solution to your toughest finishing problem.

So, step off the spot—let us make a practical demonstration of what McVee Quality Advisory Service can mean to you in terms of better finish, increased production at less cost. You will not be obliged.

# McVee

MANUFACTURING CO.  
Quality Controlled Finishing Materials  
ROCHESTER, MICHIGAN

**Tin fish swim only on the home stretch**

Aerial torpedoes have to swim only a few hundred yards on their own power. But first they must be flown hundreds of miles to get within striking range.

How far the tin fish can be carried depends on the range of our planes. Range comes from extra power per pound of weight, and therefore is largely a matter of gasoline quality. With high-octane gasoline available, our engines are designed to produce more power—more miles—per gallon of fuel.

The "fighting grade" gasoline which the American petroleum industry is turning out is just quantity for our Army, Navy and Allied planes in a triumph of chemical and engineering ingenuity. Every gallon contains Ethyl fluid to boost the already high octane rating still higher; to put in an extra punch.

Some 4000 people today are employed in the manufacture of Ethyl fluid. To all of them the sight of a plane in the sky, the sound of an engine overhead, is a reminder that their time and skill are needed.

**ETHYL CORPORATION**  
Olympic Building, New York City  
Manufacturers of Ethyl fluid, used by all nations to improve the inherent quality of aviation and motor gasoline.



## Vega Seals Riveted Fuselage Seams of the Boeing Flying Fortress



*With* **PRESSTITE**  
Extruded Sealing Compound Tape

Vega Aircraft Corporation is using Presstite Extruded Sealing Compound Tape to seal the riveted fuselage seams of the Vega-built Boeing B-29F Flying Fortress.

Like many other aircraft manufacturers, Vega has found that Presstite sealing compound provides a time and labor saving method of getting a better sealing job accomplished in the fastest possible time. The fuselage of the B-29F is sealed to keep out dust, dirt, rain, and ice—providing clean, safe comfortable compartments for the bomber crew.

This is only one of many uses of Presstite Sealing Compounds by the aircraft industry. Others include the sealing of:

- Integral Fuel Tanks
- Drop-off, Expandable Fuel Tanks
- Interference and Anodized
- De-ice Tanks
- Gun Towers
- Synthetic Glass Enclosures
- Instruments
- Stagnant Floats

Every Presstite product has been thoroughly tested—in the laboratory as well as under great stresses and in the most trying conditions of flight.

Let Presstite help to solve your sealing problems. Send us detailed information as to your requirements and let our laboratory engineers recommend the best sealing compounds for your particular needs.

in most which shows whether or not the compound has fulfilled its obligation on schedule. This all engineering information being supplied and, too, what percentage? The Consolidated supplied building information, production loading on major parts, fabricated parts, and have material shipments made on the scheduled basis? Answers to these questions, based on these charts, are the first step in securing conditions in the field.

If a subcontractor's production is not meeting the anticipated schedule, the destination is delivery and be considered by the prime contractor as his own plant—he must coordinate his own production and those units so that an adequate number of parts will be ready to ship to keep from delaying the assembly line. It is evident, then, that any tendency to fail to meet specifications by the subcontractor must be known to the prime contractor 90 to 95 days in advance, and even further to the subcontractor's first production line operation.

The problem of acceleration and deceleration becomes more and more acute, and the operation must be based with greater and greater accuracy, no material being wasted. Some fact says it was possible to keep well ahead of the assembly line in ship in plant distribution. This called for large stocks of materials. Today, however, exact quantities must be directed to high point contractors and subcontractors to take care of various defects, goods, and waste of production, and not spending up or falling off needs in various ways.

While relatively simple charts on progress control will also show a small percentage of the overall was achieved, finding a more scientific approach for checking performance and anticipated performance has become essential. The magnitude of subcontracting and the high productive rate of output units must be treated to total observations and successful statistics of the whole manufacturer's potential capacity or current performance. Specialization in subcontracting problems become necessary.

Consolidated focuses this necessity for specialization even prior to Jan. 1943, when it became very evident that the unskilled material and purchasing department—top personnel of which handled subcontracting—became essential. The material department in its own sub-departments, including production control, contained more than 2,000 employees. It had been suggested that some plans unaccompanied by the department be submitted and released in separate units, reporting to the office in charge of production.

Then Charles W. Presley, former

general manager of Union, was appointed vice-president in charge of production, plans were immediately instituted which culminated in establishment of the subcontract production department. At the same time, a production control department, material department (including the production department) and a traffic department (including the shipping department) were established as separate groups in respect to the vice-president in charge of production.

The subcontract production department has a personnel of more than 120 and will continue to grow. The cost

was enormous, including engineers and buying representatives, working to gather on buying and engineering problems, hold expediting, a staff of buyers, material buyers, and follow-up clerks, a production and scheduling group, material coordination, mathematics, and statisticians.

Responsible to the vice-president are two staff members. One concentrates on production problems and is also responsible for man-hour studies and shop loading; the other handles special assignments, reports to the Army and Navy, handles late problems, manage on projects in the plants of others.

## Auburn CERAMIC SPARK PLUG CONNECTORS



A vital part on which every spark plug of every car engine can depend—for constant contact.

Auburn Ceramic Connectors are APPROVED and ACCEPTED.

Made by one of America's pioneers in the spark plug field, and nationally known since 1910—as an institution with complete modern facilities for volume, precision production.

Made in two sizes as illustrated:

Inquiries invited from engine and battery manufacturers.

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Auburn, N. H.

AIRCRAFT DIVISION  
1229 Second St., Haverhill, N. H.

ACTUAL SIZE



No. 1041—1 1/2"

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## "Stromberg"

### INJECTION CARBURETOR

The "STROMBERG" Injection Carburetor is an important member of "The Invisible Crew" — precision instruments and controls, which B-29 Bombs derive from events as quiet as quaking in your living room to world wide events.

## "Stromberg" Carburetion

### HELPS MAKE BOMBERS GOOD FIGHTERS, TOO!

Aircraft's heavy loads are constantly proving themselves long sprints as well as deadly destroyers of bridges, war plants, oil dumps and other objectives.

Flying far beyond the range of their own senses they can blast their way through swarms of enemy fighter planes, not only because of well-timed cues and adequate maneuver but also because "Stromberg" carburetion makes them highly maneuverable. In the Flying Fortress, the Liberator and other large

bombers, "BENDIX-STROMBERG" Injection Carburetors assure correct fuel mixtures under all conditions of flight, including the diving, climbing, twisting and turning which are a part of every air battle.

The Missing constant power, made certain by "BENDIX-STROMBERG" Carburetion, means also reduced fuel demands, more economical fuel consumption and more accurate calculation of a bomber's mile making range.

**BENDIX PRODUCTS DIVISION**  
of Bendix Aviation Corporation  
South Bend, Indiana



the manufacture of the part, he enters the subcontractor's plant with the knowledge that he must reach him and his workers on the technique which they must require. A man who has worked for Consolidated on the pastels can help a subcontractor clear pitfalls which must be shown on blueprints and drawings.

After the subcontractor has been operating some time, the man is usually withdrawn. However, Consolidated stands by with help now to step in and correct production problems. Its frequently subcontractors call in to say, "We knew something was wrong out here, but we don't know what it is."

So the company needs a man who can look at the problem with new eyes — a fresh viewpoint. Usually the trouble can be solved in short order. Recently, one subcontractor showed up with a problem, and our check revealed that under his machine outside he could not hope to build the number of units he had promised. We advised, through a study of logging sheets showing machine status and reported efficiency increases, together with available man-hours per work week, that he would produce only 48 or 50 units in the given period, and he actually produced 46.

While Consolidated is subcontracting more subcontractors than many other aircraft manufacturers, it has one of the largest and finest machine shops on the West Coast, so that little machine making is turned out. The geographic location and lack of machine jobbing facilities in the area have made constant expansion mandatory. While such facilities are available in the metropolitan area, competition from aircraft manufacturing companies in that area proved a problem. They were able to exert greater pressure and obtain personnel on the use of the facilities because of the fact that they were nearby. Although other aircraft prime manufacturers place substantial machine jobbing outside, Consolidated policy has been to accelerate its progress by subcontracting major subcontracting and direct metal work include parts of a mechanical nature, such as the stress members in the beginning of this article.

As you readily be seen, the "tools shop" system of making anything "invisible" concentrates in outside small shops operated by Consolidated and under company direction has little to do with the actual business of subcontracting. It is the general belief that this tools-shop plus will meet with considerable success, but that it has its limitations. Among these limitations is the fact that at present most jobs must be non-machine work, such as light-duty, electrical, layout, tube bending, and relatively non-machined work.



## SKILL COUNTS IN AIRCRAFT WELDING!

Organized more than five years ago for the sole purpose of serving the Army Air Forces, as well as the more prominent airplane manufacturing companies, this company is in an unique position since its entire personnel and experience have been used in the development of men and facilities for the production of surplus parts and assemblies. Welding technique, particularly, has been developed to a high degree, and through recent increases in facilities and personnel, we are now ready to offer the welding experience of this company to a limited number of new customers.

## KAY PRODUCTS COMPANY

4825 CABOT STREET, DETROIT, MICHIGAN  
DIVISION OF TYLER FIXTURE CORP., MILES, MICH.

**AIRCRAFT WELDING**







**JOHNSON  
BRONZE**

**SLEEVE TYPE BEARINGS**



## Speeding Destruction



The business of dropping a package of "eggs" on Tokyo is easier and more efficient because of sleeve type bearings. The interesting feature of this application is that it employs a bearing material as new as the war.

Johnson Pre-Cast Bearing BRONZE-ON-STEEL was developed to meet peacetime applications but, like every engine product, it was easily converted to armament needs. When peace returns, manufacturers will find that Johnson BRONZE-ON-STEEL... combining the bearing qualities of BRONZE with the strength of STEEL... will give them greater bearing performance in their product. It will be available as finished bearings or in strip form for stampings. It is an ideal metal for wheels or other cast parts. Complete information can be had by writing the Johnson Bronze Company, 620 South Mill Street, New Castle, Penna.



*Sleeve  
Bearing  
Headquarters*

# JOHNSON BRONZE



## More than a ONE-MAN STAND



**T**he W & M rigid type knockdown Service and Repair Platform is more than a one-man stand. Ideal for quick service jobs and field instruction, it will accommodate comfortably one or a dozen mechanics without crowding. Frequently eliminates the necessity of taking down motors to make them accessible. Provides a rigid working surface for any height from 7 to 25 feet. Write today for catalog, prices and delivery dates.

## WOLFE & MANN

### *Manufacturing Company*

AIRCRAFT EQUIPMENT DIVISION



28th & SISSON, BALTIMORE, MD.



**Speeding  
The Ground  
Service—**

(1) Double entry code for entries of oil from 12 sources or more and (2) single entry code; (3) 99% written data for distribution management; (4) 80% use of data cell; (5) main and back ganges; (6) hydraulic elevating and positioning platform for servicing ships.

American Airlines now has new service honors—the 1942 Aviation Award for "outstanding maintenance performance." Every mile of flying by its great Flagship fleet is lubricated by Sinclair Pennsylvania Motor Oil.

hood of 3,000—in contrast to our much smaller base consisting of larger communities. In actual practice, as reflected through service information as well as through Buih's experience, shipment of individual parts as precluded an analysis of failures in the conventional way to distribute material's where they will do most good.

ship when normally anti-isolationist sentiment, once up available transport facilities, and consequently nothing for the replacement depot, when the replacement required is a fractional part of the whole. The essentially extraneous character of American philosophy is manifested here, when the interests confronting the British economy has stopped three systems in lane months.

This problem of parts shipment, however, is perhaps the most serious obstacle to getting efficient use from our already shipped abroad, and the answer lies in just such a system as has

The Stradivarius  
of all  
Gage  
Blocks

CHROMIUM PLATE

 **DEARBORN GAGE COMPANY**  
*Originators of Chromium Plated Gage Blocks*  
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\_\_\_\_\_

## SINCLAIR AVIATION OILS

RAYMOND BEND	2840 WEST CENNAH ROAD	FAIR BURNING	10 WEST 51ST STREET	373 WEST PLACEMORE STREET
KANSAS CITY	CHICAGO	FL. WASH.	NEW YORK CITY	ATLANTA



proven as effective in servicing *Aero-planes*. The foreign service also which have been sent out with these planes have saved many an otherwise prolonged delay.

In these days of critical manpower supply, the Service Training system as operated at Bell is of particular importance. This unit is in charge of Alvin V. Linn, who in 1938 taught the first state substandard class in aviators in Buffalo. In the last year, the Service Training School has turned out 160 trained representatives (say, the field, of whom very few ever find inside any existing organization. Now

all applicants must be taken from outside because of production needs.

As also very important in the selection of applicants, great pains are taken to find out the aptitudes, experience, and even biases which relate to the requirements. There are no trained men available now, so that of those interviewed, some may have had job experience related to aircraft. But a greater may have had enough mechanical education to make the start easier. If a man has around a motor boat, or had a hobby of a mechanical nature, he may also show promise. All these things are day out and used to their fullest

extent in furthering the difficult job of selection.

The first week of training, spent in the laboratory, is devoted to odd jobs of kinds to see how the men work with basic tools. From the beginning of training, such man's progress and ability is recorded so that he can be continuously evaluated and his instruction balanced.

A six weeks period following this is spent in intensive study on six major divisions of the aircraft—structure, power plant, armament, electrical system, landing gear, and propeller. There is a special classroom for each of these subjects, with very complete current time equipment, exploded-view charts, working models, real way models, and tools. The distance covered in this session is based on considerable home study to supplement the class work, otherwise it could not be accomplished.

After this, the men are put through a brief period of entering to get the feel of machine shops. This is followed by a period of work at the modification center, which, as shown in the organization chart, is within the Service Division.

Three follows a four-week period on experience where a man spends the first week as a mechanic, the second as lead man, the third and fourth as a foreman. Passing grades in this session and a man's student classification, and he becomes a Junior Representative in the capacity he is sent into the field for 60 days. Reports on his performance and knowledge indicate the next steps to be taken in his training.


When he returns, we call him in for an interview and ask him what he did not know while out in the field. He may be able to tell us and he may not, but the records kept of his activity here already determined his next course of study, which consists of three more advanced work on his specific work area.

Upon completion of this, he becomes a Representative and is again sent out, this time for eight months. In the middle of this period he advances to pay rate, and it might be said here that every step is accompanied by a proportional pay raise.

After this period of active work, a man returns once more for a finishing course in design theory which gives him an understanding of the organization side of the aircraft. A graduate of this section is a Senior Representative. Only men of this grade can be in charge of a base operating with some that are active men.


The Graduate field is divided into five districts, each in charge of a supervisor and two assistants. Out of these assistants works in the Detroit, the other on operations at the home office as representative.

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**A. Houdaille**



Remember in the early days of balloon fires when your car would develop a terrifying shimmy and nearly shake itself out of control? Imagine, then, what would happen if the same trouble overtook an airplane in taking off or landing at 90 miles an hour. Because a shimmying nose wheel on a biplane

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<p><b>Klixon Type B-6644 Switch Type Circuit Breaker.</b> Trip time 12 secs. up to 1000 amperes through 1000 volts.</p>	<p><b>Klixon Type 4242 Switch Type Circuit Breaker.</b> Trip time 1-1/2 secs. up to 1000 volts.</p>
<p><b>Klixon P4M Circuit Breaker.</b> Trip time 1/2 sec. through 1000 volts.</p>	<p><b>Klixon Push Active Type Breaker.</b> Open only for access area. Trip time 1/2 sec. through 1000 volts.</p>

**KLIXON**

constitute of his region. These men work in three-month periods, then change to stations with the other constituents.

Purpose of having an assistant from each district on home operations is to let each have an insight into the who and why side of supply. Every constituent supervisor is an accomplished officer of district affairs at the home office, either in on all emergencies with other districts and with military officials. In this way, there is no one-sided complaint from the district or the constituents, because they all have a balanced viewpoint and no understanding of the country-wide system.

Service men for foreign duty are selected by the Supervisor of each district. Once he has qualified men, for in this service they are completely on their own and have considerable responsibility with the military units (see p. 60 Don Avramovic). Selections are held in a central pool on 48-hr. interval notice. Alternate choices are held in reserve, and here cooperation is provided among the men seeking to qualify for the next selection.

Procedures in the Service Division in the Technical Maintenance Department, which coincides with Engineering. As an equivalent of the military design philosophy which recognizes the importance of service problems, this unit looks to solve the vital knowledge and experience of each department. From the time the first two pieces of metal come together, the Technical Maintenance Department follows the plane design and construction. With that thorough knowledge of the plane, from start to finish, the Service Division can complete its materials and from its men learn work of Technical Maintenance on failures and accidents in the field and analysis of causes from a design and engineering view, is of great importance to the Engineering Department, both for modification of designs in production and for pointing repetition of previous pitfalls in new designs.

In addition to company training, Camp Bell goes at Army disposal the best thinking facilities, with constant worked out for every program. The standard course is 37 days, covering in concentrated form the material given in the six-weeks company course.

In the strategic world picture, reports from about indicate a great need for a coordinated system of maintenance supply. Also, large business today has a highly organized system of report analysis and control which, although recognized, goes undeveloped as an index of equipment and trend.

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# Design Considerations for Plywood Structures

(Continued from page 167)

of the required bending strength and rigidity of the skin about its span axis. Evaluation of this involves a load-work comparison and depends upon the distribution of finger material about the shell.

Evaluation of the shear forces in the skin is based on SACA Test. Note No. 262, which defines the shear stress in the skin  $\Delta s$  of a De-Croix wing as—

$$(3) f_s = f_s \text{ for a simple dia.}$$

tribution of shearing stress.

The case at hand is somewhat complicated by varying skin thicknesses but is simplified in the following treatment. Considering a 2-in. spanwise extent of wing, equation (1) may be written as—

$$(4) \int_A^B \Delta s \, ds = \int_A^B f_s \, ds \quad \text{See Fig. 4}$$

Considering a 1-ft. vertical shear load acting on the section, the shear stress

will be obtained by assuming the rear web cut at "A" and the shear force applied by a load "X" on—

$$(5) f_s = \left[ \left( \frac{2A \, n}{l} \right) \left( \frac{1}{l} \right) - \left( \frac{X}{l} \right) \right] \cdot$$

shear stress in any point on shell where

A = Flange material cross-section

l = distance, vertical edge of wing section to centroid of A

l' = moment of inertia of entire cross-section about shell axis

1 = 24-in. distance web-shears W for vertical web cut at a far side

X = shear load per inch on rear web

f\_s = shear stress in psi

ds = moment of shell length

Substituting (2) in (1.1)—

$$f_s = \left[ \left( \frac{2A \, n}{l} \right) \left( \frac{1}{l} \right) - \left( \frac{X}{l} \right) \right] \cdot$$

Note: The shear is based on the assumption that the shear rigidity at the rear for all portions of the shell and that the rear web is incapable of resisting bending forces.

Substituting (3) for "X"—

$$(6) f_s = \left[ \frac{2A \, n}{l} \left( \frac{1}{l} \right) - \frac{2s}{l} \right] \cdot$$

Evaluation of (4) is slightly laborious for a complicated section but nevertheless feasible. The determination of "X" permits computation of the shear stress in all portions of the shell because of (2). The greatest of result may be shear way also then be determined by taking moments of the forces "f\_s" about any convenient point. A similar procedure about the vertical axis provides the value of the shear stresses due to torsional forces. Shear due to torsion is obtained from—

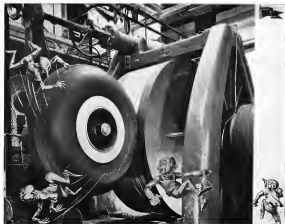
$$f_s = \frac{P}{2A \, t}$$

and the algebraic summation provides total information as to the total shear stresses at any point.

The above method was applied to a test wing panel of constant chord and width of the material of shear properties obtained experimentally. Comparison between test and computed values were 26.1 percent from comparison versus 24.8 percent from the experimental determination. The error must be due to be sufficiently close in view of the fact that the stress in the skin, from rear-ended loads a 100-in. one-lap joint.

## SKIN STIFFNESS

Computation of the bending moments in the shell is feasible using the method described for a given angle of



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shock and control by force. If, provisioned to those obtained from equation (2). Introduction of several special features, for any degree of accuracy, inclusion of the three additional instruments introduced by each spreader. Computations involved by this extension have been sufficiently appealing to encourage their inclusion on wings constructed to date, although the value of such investigation is undeniable.

Following well recognized design practice where confidential information is available, a careful estimate was made as to the size of this extension necessary. First estimate proved to be conservative in that the stiffeners did not fail during load tests and subsequent work was then based on the first guess with the depth varied somewhat in proportion to the square root of the load. Original structure of the type was arranged with a diamond pattern of reinforcement in the lower half section and chord shear rigidity would be enhanced by this arrangement.

To simplify, Fig. 4 depicts a typical standard fabrication where the shell may be constructed on a single form and machined complete with stiffeners and half the leading edge. Two shells from the same form, together with the rear spar, comprise the desired structure.

Fig. 5 is an example of early wing construction. Here, the web is added from the forward flange to the flap/airfoil cut-off, with the leading edge and rear web mid-glued into place as final assembly operations. And in Fig. 6, showing intermediate construction, the method is similar to that in Fig. 7, except that the flanges are wide and machined to contour.

Fig. 8 is a construction where the outer shell, welded on an "inside" form, is completed in one operation. Here, the tube spacer is replaced by a discontinuous physical separator, and the rear web is glued in as a final operation.

Fig. 10 shows an extreme variation for late covered T.E. This scheme is made with the web replaced by spacers. The interior, with the exception of the horn bar, is completely open for inspection and repair.

Figs. 4 through 10 indicate the various stages of development of this arrangement. The first wing sections were constructed with diagonal sub ribs of 1/2-in. x 1/2-in. spars, with post spacers at each intermediate. Observations during tests indicated the necessity of using separate flange material which was incorporated after the fashion of Fig. 7. In the interests of weight economy the solid leading edge used in the stabilizer was replaced by a molded leading edge in the wings, which was mid-glued in place as a closing piece. In Fig. 9 the stabilizer spacers have been replaced by a plywood spacer with

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the old process of the leading edge  
thrusting by making the shell rigid.

In this instance the wing is "spring"  
open to release the force and is com-  
pacted by the resistance of the forward  
spare, the rear channel, and the ribs.  
Forward ribbing has been replaced by a  
slight-wave rib without spars or ribs.

Examples of each of these wings have  
been put through tests, although not all  
have been carried to destruction. Through  
data has been obtained to indicate the  
viability of having a design on the fol-  
lowing arrangement:

- Flange material designed to re-  
sist bending moments.
- Wing shell between flange material  
designed to carry shear stresses as  
determined from Kipp's Law (1) through (4).
- Note that the leading edge must  
be of sufficient rigidity and strength to  
prevent failure by buckling due to shear.
- Rib area may be estimated from  
the following:

V <sub>h</sub> Loading Adv.	Rib Dist.	Panel Area	Dist. Span	Yield Stress
70 psi	1/2"	18" x 18"	3.4/40	Yes
120 psi	1/2"	8" x 8"	4.1/36	Yes
530 psi	1/2"	30" x 9"	3.4/40	No

### Our Questions

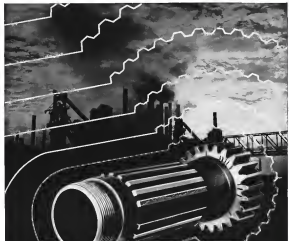
A number of interesting points have  
been brought out in the course of tests.  
Of primary note was the possibility of  
obtaining a sufficiently satisfactory  
leading edge by designing a thickness  
to prevent buckling under shear loads.  
Another point of interest was the ap-  
parent resistance of the flange rib  
joint without the plywood skin. This  
point was brought out by removal of one  
panel after removal of the plywood  
skin between stiffeners.

Preliminary tests had indicated the  
probability that the buckling of the  
sub-rib at a distance would define the  
strength of the panel. During tests,  
the wing with the end cap joint carried  
the predicted loads without failure of  
the sub-rib.

The three paragraphs are offered to  
offer coverage efforts at structural  
analysis. Despite the fact that struc-  
ture and structural engineering is an  
exact and venerable discipline there  
is still a great unexplored region. The  
efforts in research have been largely  
based on weight reduction from the  
standpoint have been satisfactorily  
succeeded.

It should now be legitimate to turn  
at least a portion of the efforts of the  
scientific structure towards explana-  
tion of simplified structure. Based on  
the achievement in the past few years  
an increased weight efficiency, it is read-  
ily possible to achieve comparable im-  
provements in labor efficiency and labor  
cost economy.

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## Theory and Technique of Perspective Projection

(Continued from page 374)

quires the summation of step 4 (of the procedure just outlined) for a few lesser starting points, but it does not require the redrawing of the top view of the object. This slight admission, however, is entailed by the superposition.

If a woman's-eye view of the box is desired, then the  $AP$  is placed below the  $BP$  (upon which the box is assumed to rest) at a convenient and proper distance. Assuming again that the sight between the  $PP$  and  $AP$  is 45 deg, that the vertical edge  $BP$  is again the nearest to  $PP$ , the top view of the box will be drawn in the indicated position of Fig. 16, if the auxiliary view is given as shown, and if  $PP$  is in the top and rear view in an edge view, i.e., Type 1. Recall that in order to obtain a perspective with a small amount of distortion, the  $PP$  must be so placed that the  $CP$  will be somewhere in the center of the perspective. Following the rule that  $ML$  is the intersection of  $BP$  and  $PP$ , and that  $BP$  and  $PP$  are parallel, the  $ML$  will fall below  $GL$ , as Fig. 16 indicated. Applying Principle 2, the  $UVP$  (up vanishing point) is where a sight line parallel to the line of which line  $AP$  is part, passes  $PP$ . Note that the  $LVP$  and  $RVP$  will be at the bottom of the figure, since  $ML$  is also there. As indicated in the outline of procedure immediately below, for obtaining the woman's-eye view of Fig. 16, a construction of Method 1 and 2 is probably the best to use, in general, for three-point perspective, with Type 1 or 2. Referring to Fig. 16,

1. Locate  $LVP$ ,  $RVP$ , and  $UVP$ .
2. Determine the perspective of  $E$  by Method 3. A horizontal projection line  $E''$  intersects a vertical projection line from  $E''$  at  $E'$ .
3. Similarly locate  $H'$ .
4. A line through  $E'$  and  $H'$  will locate  $RVP$  on  $ML$ . (In this case,  $RVP$  is found by Method 1.)
5.  $G'$  is where the line  $H'$  ( $LVP$ ) intersects the vertical projection line from  $M$ .
6.  $I'$  is the intersection of line  $G'$  ( $LVP$ ) and  $E'$  ( $RVP$ ).
7. Locate  $A'$  in a manner similar to that used in 2 to locate  $E'$ .
8. Determine perspectives of enough of the remaining points, as outlined in items 2 through 7 above, and draw in the complete perspective.

Here again, the author's superposition method may be used to great advantage in making perspective projections on a piece of tracing paper placed over the construction engineering drawing which employs orthographic projection. This is illustrated by Fig. 17 and by the outline of procedure immediately below.

Referring to Fig. 17, and temporarily ignoring the lower perspective.

1. On the engineering drawing, locate and view of  $PP$ ,  $AP$ ,  $ML$ ,  $GL$ , and  $UVP$ , also draw ( $ML$ ) perpendicular to the end view of  $PP$ , where a sight line, parallel to ( $ML$ ), passes  $PP$  (and  $UVP$ ), and draw  $UVP$  perpendicular to  $PP$ , and view, from where a sight line parallel to  $PP$  (and view) passes  $PP$ . On the tracing paper, locate top views of  $AP$ ,  $ML$ ,  $RVP$ ,  $LVP$ , and ( $BP$ ).

2. Determine points for  $PP$  (top view) like  $P_1$ ,  $P_2$ , etc., by the construction of step 4 in the construction of Fig. 15a (beginning "Find  $A'$ " by method 1, etc.). For example, ( $A'$ ) is determined from ( $A''$ ), the passing point of a sight line to  $A$ . And ( $A''$ ), laid off along ( $BP$ ), gives ( $A'$ ) for the horizontal projection line intersection ( $BP$ ),  $A'$  at  $P_1$ .

3. Move the tracing paper from the top view and match the  $ML$  with ( $ML$ ), being careful to locate  $Q$ ,  $LVP$ , and  $RVP$  at such a position as to place the perspective in an unoccupied portion of the available working space.

4. Lines through  $P_1$ ,  $P_2$ , etc., perpendicular to ( $ML$ ), will intersect lines through perspective points in the right view—like ( $A'$ )—and perspective points. For example,  $A'$  is on a perpendicular to  $PP$  from ( $A''$ )—where ( $A''$ ) is the right view of where the sight line to  $A$  passes  $PP$ —and also on a line  $a$ , which has been drawn through  $P_1$  after the pickup of the tracing paper.

5. Enough points are obtained by this superposition method and by using vanishing points wherever expedient to obtain the complete perspective.

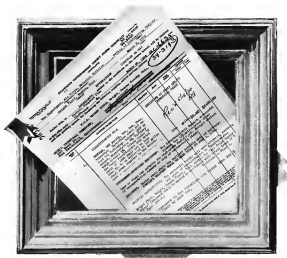
It is to be noted in Fig. 17 that the end view of the engineering drawing has been revised since its normal position in order that the perspective could be placed in a reasonable position, and not near the bottom of the available working space.

In outlined above placing the  $RVP$ , say, in the right of  $LVP$  after the pickup. This is how they appear from the  $PP$  in front of the  $BP$ , which is the plane of the paper at the superposition. If these positions are reversed, the lower perspective of Fig. 17 will be obtained. This would be the perspective reflected by the  $PP$  to the  $BP$  and located at equal distance on the opposite side of  $PP$ .

Figs. 18 and 19 show the application of the principles, rules, and methods previously explained and defined. The problem of obtaining a common perspective of the wing-tip fuel tank installation of one of Consolidated Aircraft's DET flying boats, is not elementary.







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is typical of the advanced problem solving professional engineers and draftsmen are more and more being compelled to solve in the production of a steady stream of needed commodities by workers, most of whom are unskilled or semi-skilled in the rendering of the conventional, photographic engineering drawing, but who can at a glance read a pictorial drawing of the type shown in the two figures.

The figures do and show the objects in complete detail, but they do reveal enough of the basic graphical solution to the problem for the engineer or draftsman of average ability and experience to proceed independently to the complete solution of the detailed object. The basic points, whose perspective have been obtained in the figures, are those which the artist would first attempt to locate on his paper when using the various methods of "artist's" perspective. Definitely, he could not always obtain the correct points. The engineer or draftsman, with average ability and experience, but with no "artist's ability", can determine the exact location of these basic points for the artist, who can then exercise his ability to sketch their curves, detail the perspective, and properly render or shade the sketch or drawing.

Fig. 16 illustrates the use of Method 1, Type 2. As pointed out, no limitations of TP's are required, but the end and top views must be redrawn if the TP in the end and top view is to appear as an edge when obtaining bird's eye or worm's eye views. The latter method, a combination of Methods 1 and 2 used in conjunction with the author's superposition method, is that of Fig. 18. Redrawing the top and end views of the object is not required there. Although the constructions and methods used in Figs. 17 and 18 are essentially alike, a brief explanation of Fig. 19 may be helpful. Therefore...

1 On engineering drawing, locate end views of PP, SP, JH, and UJ and, on tracing paper, locate top views of SP, JH, XFP, LFP, and (XFP).

2 Determine the points, like P<sub>1</sub>, in the top view on the tracing paper.

3 Now superpose the top view, sketched on 2 above, on the perspective picture by marking (ML)<sub>1</sub> and (ML)<sub>2</sub>, being careful to locate Q at such a position as to place the perspective to be drawn in a compact portion of the available working space.

4 Lines through points, like P<sub>1</sub>, perpendicular to (BL)<sub>1</sub>, will intersect lines through pivoting points in the right view, like (A)<sub>1</sub>, at perspective points, like A<sub>1</sub>.

Note that in Fig. 16 end view has been raised above normal position so that perspective obtained does not lie too near bottom of working space.

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## Aircraft Tool Planning

(Continued from page 147)

elimination and establishes all definitely located major attaching points (these may include main beam, struts, rear shear beam fittings, hinge lines, track locations, etc.). It is necessary for the builder, drafting, and construction of new drawings from these and the small details or subassemblies to the master detail of the major assemblies. Working from one or several master means the illustrates confusion and as the solid base and foundation of all good design. The tool planner should hold fast to this ideal. After tools are built and in use they need frequent corrections and checking, thus the master tool not only serves to build but to keep the tooling accurately aligned.

### 5. Importance of Part or Assembly

The planner must know the importance of the job to be planned. If it is a detail, he must take into consideration its use in the assembly, whether it is a simple support, an important structural section, or one that stresses loads. In all cases efficient tooling is of prime importance and the job must be conscientiously thought out first before ordering tooling.



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### 6. Forming Quality of Specified Material

Every engineering project specifies the material from which the part is to be made. From this detail the planner can select his tools, not only to form the part but also form it with regard to the special specification of the material. If a soft heat treatable material is to be formed, the heat treating and warping effects must be considered. Should warp be serious, reinforcing immediately after quenching may be necessary to reset the metal. If material is the nearest heatable type then dry work hardening qualities must be considered. In deep draws, several annealing processes may be necessary. Conservative thought for future work should be toward the use of "505", non-bake materials, which would greatly decrease warpage problems.

### 7. Necessary Jigging

The proper type and construction of jigs calls for considerable thought and vision. The jig serves a definite purpose in that parts are held, and/or holes drilled, so that details may be aligned together, or assemblies mated to each other. Jigs constructed of wood are

generally used for small assemblies—are used for major assemblies only in the experimental stages of a new design. Wood jigs are low cost tooling, requiring a short time to construct and using an inexpensive material. Caution must be observed in selecting wood jigs, determining first the type of job they are to perform, and secondly the manner of use or assembly involved. Wood wears out quickly if not handled properly, and drill bushings become loose, leaving accurate locations.

Aluminum construction of steel is quickly replacing wood jigs. Dural is worked much as easily as wood, is stronger, and wears better. Dural has the reputation in that bushings come loose; but the wood jigs, being jigs are sufficient for small work. They should not be used where accurate interchangeable holes are drilled in large assemblies, or for jigs of major assemblies. Steel jigs are the most satisfactory for accuracy, maintenance of location, strength, wear, and mass production. Steel's drawback is in its expense, a tool design or work on steel jigs, the working and cost of steel itself is expensive, and steel is a priority steel today.

Importance of the job must be considered before ordering too many steel jigs. Should the detail or assembly be small, but its location or hole layout important, then steel jigs are necessary. Large steel assemblies are necessary to support entire assemblies, this weight is another of several points to consider.

Sound judgment, knowledge of jig construction and costs, complete analysis of the job, and experience are the best guides in deciding upon the best planning procedures. Whether to use an assembly jig, drill jig, or assembly drill jig, events look to the type of construction planned, the importance of the detail or assembly, the assembly location, interchangeability, and the ultimate test cost.

### 8. Assembly Location

In planning an assembly, consideration must be given to the importance of holding various positions of the structure. The over-all length of a structure must be definitely held, attaching details located, skin, stringers, and longerons steps provided, hinge lines determined and maintained, sheet and ribbed reinforcements held, windows controlled, track locations specified, etc. Each point must be ferreted out by the responsible planner. This item should be considered first as part of the whole structure, then merely as a separate unit.

### 9. Complicated Assembled Structures

In major assemblies there are areas, within the structure, that are inaccessible. Subassembly of these areas include this problem. Building of various



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assemblies break it down, eliminating a laborious process of detaching that would have to be assembled, thus compressing the assembly job. Sub-assemblies speed major assembly time, make complicated structures relatively simple, and tend toward standardization procedures and more bench work. Hence, sub-assemblies come to play a more important and practical role in the production and assembly of airplanes.

#### 10. Bench Assemblies

Small and compact bench assemblies should either be provided for by engineering design or else can be produced by production assemblies created by tool planning. Bench assemblies leave major assembly time and reduce the complexity of such. In building these assemblies, a worker has all of his tools and parts concentrated and within reach. Also, by means of adding small items three upon small assemblies, the major assembly becomes a fairly simple structure.

The bench worker tends to become skilled at his task and in many cases works out his own methods of assembling which add to his satisfaction. A man doing a specialized job tends to increase output and quality of workmanship. Then, by means of small complete assemblies, and the shared planning of such, the tool planner can do much to aid production.

#### 11. Production Assemblies

After the program for the current model is under way, or even before, it may be found that if the shop's structure could be put together in a different manner, production could be increased. If sub-assemblies were made more complete, major assembly work could turn toward the more important work of maintaining coordination and inter changeability.

Production assemblies are created by the tool planner and production engineer and differ from the engineering assemblies in that they make the same assembly either more complete or less complicated than originally designed by engineering. No parts are omitted, although illustrations of the production assemblies are desirable.

Production assemblies accomplish the following:

- Facilitate production
- Create better and more complete sub-assemblies
- Reduce "bush" problems
- Require no engineering great changes
- Produce more bench assembly work
- Reduce setup and final assembly time
- Make major jobs less complex in structure

The tool planner must determine when a production assembly is necessary. Some models may not require

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them because of their complexity. It must be noted that once production assemblies are made in one portion of the factory they are available throughout. Trouble lies in the fact that production assemblies have no engineering prints as of exact nature and, therefore, when released on a major scale, tend to magnify the assembly line. With an eye to the future it will be noted that today aircraft engineering and tool planning are working together during the period of the design development; all of which means that production assemblies will be a thing of the past as future ships will come from the drawing boards in production products.

#### 12. Design Requirements

Major jigs, fixtures, and standard design requirements. Designs are very

necessary and eliminate unnecessary thought and work for the tool maker. It leaves the job of tool making to the man best equipped for that job and tool designing for the man of creative ideas who knows the entire problem. On the other hand, many fine jigs, fixtures, and various types of dies, can be made without tool designs. Designing and making them requires time to make, store up the work, since the design must be finished before the jig, fixture, or die can be made.

The following aircraft tools do not, as a rule, require tool designs:

1. Trenches
2. Form blocks
3. Dry hammer dies
4. Molded detail and subassembly jigs
5. Router blocks

The planner must be creative in solving for tool designs. Should the job require extreme accuracy and that there be no margin for uncertainty, a design of the jig or fixture is essential. Several dimensions require the best in tooling, and the best tooling requires designs. If a jig or fixture requires for location points and the job is severely loaded, designs of the stand may be bypassed. Good judgment, complete knowledge of the job, and logical reasoning will, as a rule, enable the planner to make the tool design in dealing with the advisability of ordering a tool design.

The remaining eight points of consideration in proper job analysis for tool planning will be outlined by Mr. Eakin in the May issue of *Aircraft*.

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### Aviation's Pincer in the Controlled Materials Plan

(Continued from page 155)

in production methods, the actual requirements often prove less than estimated.

In one case, for example, new methods of working extrusions were so effective that the company found it actually got 162 percent of requirements. In this instance, however, production schedules, coupled with delayed deliveries, resulted in all the material being used. Although the use just stated is an extreme, inventory limitations are the rule rather than the exception in the aircraft industry.

However, for every inventory excess, there is undoubtedly at least one shortage—a plant may find itself long on aluminum sheet and unusually short on aluminum rivets, perhaps just the reverse of another plant.

But, it is pointed out, if applicants for materials submit accurate CMP-4A or B forms, the substance will show up on the applications and can be dealt with promptly.

In many cases inventory adjustments have already been made or are currently being made between plants through Aircraft Subdivision Unit district offices.

In addition, the inventory report which was to have been filed on May 26 (the CMP-3 and ASD Supplementary) can be used to disclose any unbalanced inventory conditions. Nevertheless, many industry representatives are pressing for modifications which will speed re-distribution of materials, and there is every evidence they will now be in operation. Whether minor changes take the form of a "Pitiful Echoing of New Materials" or some other centralized agency to speed re-distribution is, to all intents and purposes, largely unknown. The point is

that WPS officials and industry representatives have worked together, and are working together to set up machinery whereby the industry may not only know at all times what material is available, but will have the means to get it into production at the earliest possible moment.

Adoption of such a plan would go far, it is felt in the industry, to eliminate one of the major criticisms of the plan. That is the necessity for the manufacturer expending vast sums of precious man-hours in establishing proof of his needs when, in fact, it is sometimes physically impossible to do so. Such a move might result in a second major modification regarding acquisition and filing of the all-important bills of Materials.

It has been proposed that there be simplified by setting up "average plants." This means that the industry, perhaps picking some of its members, would make detailed studies of the major types of plants, finally arriving at an "average" light, medium bomber, heavy bomber, etc. To find a quarter's material needs for, say, a medium bomber, the manufacturer would take the average figures, multiply them by the number of planes called for in his authorized Production Schedule, and the result would be his Controlled Materials requirements for that period. If, nevertheless, the manufacturer (of the model) he found was requirements: more than data listed, his excess inventory would immediately be made available to the re-distribution agency which would turn it over to a plant whose requirements had been found to be low.

This plan, of course, might work in some of some standard shapes and

uses, but would not handle extrusions, forgings and other shapes, nor would it work for steel alloy forms or special composite parts. The end conclusion would be, it is felt, that there is no thorough substitute for accurate bills of materials.

It should not be inferred that the aircraft industry wants to re-write the Controlled Materials Plan. Such is not the case. Aviation manufacturers believe that CMP is fundamentally sound and that it can be made to work. What they have appeared to want, almost all, is assurance that CMP won't be jettisoned overnight, for it is already impossible to rewrite the production plan in "three months-to-three months time." An aircraft production line cannot be turned on and off like a stream of water. The statement has been given in every WPA statement, both on and off the record. Board officials point out that the plan has been designed to be flexible and that it will be so administered, taking into account the different industries and strategic requirements involved.

While the principle of CMP is sound, its operation—by the very name of the industry termed—undoubtedly has been, and will be, as rough going. As a service to the industry, under the plan, Aviation presents herewith a summary of some of the most-frequently asked questions, together with answers as worked out by WPS officials sitting in round-table discussions with representatives of the defense forces and the aircraft industry.

Q.—To what extent, and at what time, will the aircraft industry be included in other materials as well as controlled materials?  
A.—For the second and third quarters, only aluminum, steel, and copper will be considered as controlled materials. All others are to be handled as non-



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controlled materials, sales or retail advice to the customer is given. CMP is, however, flexible to permit inclusion of additional materials in the future, if necessary.

2.—What is meant by "program"? A program is a broad classification of end products—such as airframes or engines—which is produced in a specified period of time. An authorized program is one specifically set up by the Requirements Committee of WPI or the Civilian Agency (such as the War or Navy Departments or the Aircraft Reliability Unit) or Industry Division within the limits of its total allotment. For the aircraft industry there are two programs: (1) Aircraft and airborne equipment and (2) Ground and deck equipment, facilities, and miscellaneous items not otherwise covered.

3.—What is the procedure under which allotments will be received and extended by a Prime Contractor, who is defined as any person who receives an allotment of controlled material from a Civilian Agency?

Currently, the Requirements Committee divides all available controlled materials into approximately 50 programs. The Aircraft Reliability Unit, which acts as the working agency for the Aircraft Resources Control Office, subdivides these programs on the basis of the applications received from prime contractors, and each contractor will receive an authorized production schedule for each production lot or model of aircraft, together with allotments of controlled material required for all these schedules. Advance allotments for the third and fourth quarters of the year are also being made up to specified amounts. These production schedules will not be the same in the nearest months, but they will be based on them as closely as possible.

Under CMP, the entire responsibility for establishing the finished product rests with the prime contractor. He furnishes the bill of material and the application to build a specific part of an over-all program and the Civilian Agency gives him with the total allotment to complete the authorized schedule. The prime contractor may then deal with secondary contractors (which subcontractors or subcontractors) in the most efficient method to meet his requirements. He may either fabricate all the products of the authorized schedule himself, or he may turn out part of the schedule to secondary contractors. But wherever a portion of the primary contractor's schedule is extended to a secondary Class A contractor, it must be accompanied by an allotment of controlled material.

Customarily, CMP procedure specified that this allotment be authorized by extension of the bill of material number

containing the identification of the Civilian Agency, the program number, and the prime contractor's specific schedule. It was found, however, that for many manufacturers this procedure was too cumbersome and involved too much paper work. In addition, many products sold to a large number of customers are classified as "E" products as a result of the complicated procedure for handling "A" products. To overcome these suggestions, it was decided to grant prime contractors their allotments of controlled materials on a quarterly basis instead of monthly. The authorized production schedule, though, is issued by months. Since no customer may purchase controlled materials in greater quantities or at a rate faster than necessary to meet his schedule, orders for controlled materials are to be specified for delivery as required.

Second important step in completing procedure for handling "A" products lies in the extension of allotments. Agencies that issue bill of material number to prime contractors in order to allot a specific quantity of material to a specific production schedule in extending allotments for secondary Class A products and for controlled materials, the prime contractor must extend the same program number and quantity limits. All delivery orders for

secondary products may be grouped under the two aircraft programs rather than by extension of each aircraft number individually. In this instance, prime contractors will have two or more aircraft numbers, extension of the program number alone will greatly simplify accounting records and other paper work. With each authorized production schedule, the prime contractor receives a performance rating to be used for procurement of Class B products and non-controlled material required to meet authorized production schedules.

It is advantageous to extend the program number along with the performance rating when, under CMP, preference ratings with a program number are granted preference over all other equal preference ratings. However, the preference rating received with the authorized production schedule should only be used to secure production materials, and should never be extended for the maintenance, repair or operating supplies. A specific rating is provided under CMP Paragraph No. 5 to secure such supplies.

Responsibility for completion of the production schedule for individual production items is vested solely in the prime contractor. This responsibility comes with it the severity of costs, making close relations with secondary



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consumers to make sure their bills of material and applications are accurate and that such inventory carries out his part of the production.

4—Does the term "maintenance spare parts" mean "prime contract spares," "short order spares," or both?

Maintenance spare parts are those purchased on specific contract; (short orders) that is, they are the spares required to maintain aircraft already produced.

5—What is the procedure for ordering material to manufacture spare parts?

Application for material to manufacture spare parts which are to be delivered immediately, with completed aircraft should be included with production requirements. And both should be requested on form CMP-4A, the Application For Allocation of Controlled Materials For Class A Products. Requirements for maintenance spares, which are primarily produced on separate contracts, may be applied for in filling a separate CMP-4A covering requirements for maintenance spares only.

6—Will the Aircraft Scheduling Unit make use of long range forecasts included in CMP reporting for spare parts shortages at the quarter already initiated? Wouldn't it be adequate simply to report actual requirements for one quarter and schedule the rest at con-

cluded "information" reporting which, after all, merely reflects a trend already well defined?

The purpose of including requirements on form CMP-4A and if for more than one quarter is to enable the Aircraft Agency to make advance allocations, thus reducing paper work and enabling a manufacturer to place delivery orders which will cover a longer production period. It has been found impossible to base allocations on just one quarter, since a single quarter's requirements must be adjusted to the projected production schedule as well as inventory, and therefore must be used as a base for re-allocating a trend.

7—Will a manufacturer's inventory be scheduled or scheduled to maintain operations at practical production levels due to material allocation rate or assigned orders at the mill, and provision will be made to cover enough at this material to keep customers up to a small operating level?

Some manufacturers have already placed purchase orders with the expectation of replenishing inventories, as looking them up. In form CMP-4A, the Application For Allocation of Controlled Materials For Class A Products, Part II, Production, for use, the third quarter, there arises the question of whether the backlog of unfilled purchase orders willing for delivery in, or prior to, that

quarter should be included with production requirements. In form CMP-4A and if applications for the third quarter, the manufacturer should include only the material needed required for his authorized production schedule, for provision has been made on both forms to take account of inventory requirements.

In describing these forms it was emphasized that, because of inventory reserves, actual current material requirements would frequently be less than production requirements as listed on the Bill of Material. They do not, however, anticipate substantial replenishment of inventories beyond quantities required to cover authorized production schedules. Substantial requirements to rebuild inventories within a short time could otherwise be met only by changes in authorized production schedules.

Upon receipt of a controlled materials allotment, the manufacturer should extend the program number to his outstanding purchase orders, being in mind that program numbers can not be extended for more material than has been authorized in the CMP allotment. This, of course, will not correct a deficiency in inventory. But, immediately after the close of the second quarter, when such prime and secondary consumers can know what deliveries have been made by mills in the previous quarter, a determination of any inventory deficiency can be made. Prime consumers should submit reports of inventory deficiencies from their Class A secondary consumers.

There have should be directed to the Aircraft Scheduling Unit a supplemental CMP-4A application, clearly marked "supplementary application for inventory to reduce inventories to maintain effective working level." This application should specify maximum additional controlled materials needed to bring delivery customer down to its general working level. Each supplementary application should be accompanied by covering letter which fully substantiates the need for the additional inventory requirements.

It is pointed that large quantities of materials to rebuild inventories will not be available between now and the end of the second quarter, it must be anticipated that rebuilding can be accomplished only over a period of time. Meanwhile, manufacturers should investigate all outstanding orders, looking toward elimination of all that have become obsolete or are duplicates.

It should be emphasized that all supplementary applications will be given consideration by the Aircraft Scheduling Unit and its report, together with recommendations, will be made to the WPR for steps to now be taken to correct situations needing adjustment.

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8.—Insure that a manufacturer develops a built-up system to replace a heavy customer, but that final development work and tests are not completed until after filing of bills of material—this if at present practical to build the part of steel, may the company as notify the scheduling Unit and have its production schedule increased, provided it had been not due to a shortage of customers?

9.—If it is known that a substitution is being made for a critical item the production schedule would not be referred in the final release. However, if the production schedule had been set only because of limiting factors as described in the question, the schedule might be increased as soon as a suitable substitute was available.

10.—In case a manufacturer has failed for metal allocations—doesn't work out, may the manufacturer apply for additional quantities of metal or must he reduce his production schedule?

11.—If it will be necessary to revise the production schedule. The manufacturer or should submit a supplemental CMP-44 for the original material, in this case steel. Small quantities of substituted materials will be withheld for emergency distribution in case such situation. The manufacturer should, however, do the best to anticipate difficulties in setting or working with such alternate materials to provide the Client's Agency with as much advance notice as possible.

12.—Will a manufacturer apply for substituted materials and fabricated parts in built experimental planes and in combat research or other experimental equipment?

The experimental aircraft in special projects, including the substitution of materials, the manufacturer must file individual CMP-44 applications. Requesting estimates may be used to determine the material requirements. The usual research and experimental projects using the various materials in limited quantities, the manufacturer may file a single CMP-44, but a covering letter describing the field of experimental work should be attached.

13.—If a manufacturer, in his applications, classifies parts or materials as Class A products when they are actually Class B, what is the procedure to secure an additional allotment to correct the situation.

He should then file a supplemental CMP-44 application to secure an additional allotment to cover this requirement. Care should be taken not to file a CMP-44 application, as it would automatically be rejected by the appropriate industry Division.

14.—Since controlled materials producers are permitted to ship as long time during the allocation period be-

tween the 15th of the month preceding the allotment month and the last day of the month following the allotment month, new customers be forced to maintain large inventories to absorb possible shortages from shipping delays?

In the interests of maintaining maximum production of controlled materials, producers have not been forced to set strict rolling rates within an indefinite 30-day period, as this might seriously curtail output due to loss of production time in excessively frequent set-up changes. Nevertheless, controlled materials producers must submit any order for shipment in any month of that order, together with authorized orders already on hand calling for delivery during that month, plus any authorized orders carried over from the preceding month, total 130 percent of the producer's production division for that particular product. This over-allotment in producers will be adjusted up or down to keep each at full capacity without allowing backlog, in some cases. Controlled materials producers must, however, make delivery of each authorized order to date to requested delivery date as possible. They are obligated to ship within the month requested, unless reference conditions make it impossible.

In some cases, producers' schedules may necessitate delivery up to 15 days ahead of the specified month, but it is felt this will not create a hardship for the customer. But while the majority of controlled material orders may be delivered to the month specified, a producer may be unable to complete delivery on some orders until the following month. In such cases, he must advise the customer in time so it is evident that delivery cannot be completed in the month specified. Thus, if such delay will interfere with the customer's authorized production schedule, he should apply to the Armed Scheduling Unit for relief.

If, after accepting an authorized controlled material order, a producer is unable to make delivery in the month of the month following the month specified, he must immediately notify the Controlled Materials Division so that it may take action to meet delivery requirements. Suppose, for example, a steel producer accepts work on order with delivery specified for June but finds shipment cannot be made until after July 31—then he must promptly advise the Division, which will take steps to insure that the manufacturer gets the necessary steel.

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It is considered adequate to provide for steel divisions in deliveries which will be unaccounted.

11—When shipment numbers are issued, necessary authority will reach in place orders with producers. What machinery will control the distribution of these orders, and how will it be done?

CMP Regulation No. 1 has been amended to assure distribution of the quarter shipments in the months with in that quarter so that the first two months won't be over scheduled. Thus for steel and copper, not more than one third of the quarterly requirements may be placed in the first month, nor more than two-thirds in the first two months. For aluminum, the ratio is 30 percent for the first month and 65 percent for the first two months. All other materials should be ordered consistent with authorized monthly schedules and in support of the shipments just mentioned for controlled materials.

12—How do modifications control the flow of their requirements of controlled materials?

A motor operated by an aircraft manufacturer will get its materials through a separate CMP-4A application filed by the manufacturer. A motor operated by an airline, or management other than a manufacturer, is also classified as a prime consumer and therefore will make application direct to the Aircraft Scheduling Unit, using form CMP-4A.

13—Why large subcontractors be considered prime consumers rather than secondary consumers or at present?

A subcontractor is a secondary consumer regardless of size. The Controlled Materials Plan was created at Washington in the prime consumer and through him to others—wherever possible. This is done so that final responsibility for all phases of production rests with the producer of the end product, that product, in this case, being complete aircraft.

14—Do subcontractors, as secondary consumers, report their secondary positions to prime consumers when submitting bills of material? Also, how much responsibility must the prime consumer assume for verifying the secondary consumer's inventory and the use of materials produced by the secondary under the prime consumer's allotment number?

Inventory positions are not reported on bills of material. However, necessary consumers will take their inventory positions into account when applying to the prime consumer for materials to meet an authorized production schedule. As to responsibility: The prime consumer is charged with seeing that his subcontractors produce their authorized allotments with the materials allotted them.

15—What are CMP provisions for

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servicing methods and equipment where by a mechanic may fulfill a need to be free for future related work in aircraft and engine mechanics.

Private contractors looking for contractors must find material requirements on forms CMP-1A and equipment requirements on CMP-4C for "A" items, and PD-1A for "B" items, except for equipment items of less than \$500 and this, which may be secured as operating supplies under CMP Regulation No. 3. Such applications should be to the Aircraft Scheduling Unit should be accompanied by a covering letter fully

describing the training program. Requirements for training items and Navy personnel should never be confused with materials and products needed for production, which are applied for on a full set of Materials as the CMP-4 form.

25—Special requirements for restricted materials and fabricated products arising from engine training programs be included in B3b of Materials, CMP-4A, or "B" applications?

No. Training programs are usually conducted with secondary material. But if training cannot be given with such material, requirements should be filed on separate CMP-4A applications.

## Proper Care of Compressed Air Plants

(Continued from page 180)

for the power cylinders. Oil used in compressors of single-acting trunk piston type must be adapted to both compressor cylinders and running gear and must be of the type known as compressor cylinder oil with proper specification for the machine. Double-acting piston type compressors, where flame running parts are separated from non-running cylinders, require cylinder oil for the compressor and crankcase oil for running gear (Fig. 3).

When filling mechanical lubricators prior to starting, break the oil line joints against the cylinders and crank lubricator by hand until oil appears at the joints. This will ensure an immediate oil supply when fuel are re-actuated and machine is started.

Compressors vary in type and use to be selected in one and oil specification. However, one of the Compressed Air Institute specifications which is most applicable to a majority of types is as follows:

Flash point.....350 deg. F. minimum  
Viscosity 5.8 Unit at 180 deg. F. ( )  
Viscosity 8.8 Unit at 210 deg. F. ( )  
Viscosity 12.5 Unit at 240 deg. F. ( )  
Pour point.....-45 degrees  
Frost point.....-30 deg. F. max.  
Neutralization No. ....4.0 max.  
Corrosion carbon residue.....  
.....0.9 percent max.

Steam cylinder requirements will vary according to steam temperature. For moderate temperatures, the Compressed Air Institute gives the following specifications:

Flash point.....500 deg. F. minimum  
Viscosity 8.8 U. at 210 deg. F. ( )  
Pour point.....Solid less than 200  
Frost point.....-30 deg. F. max.  
Corrosion carbon residue left on  
evaporation.....4.5 max.  
Compressing.....9 to 22 percent max.

The noncompressing table gives more

than food rates under good conditions, to be stored according to conditions and results of cylinder examination.

In the case of gas compressors, where the gas has an effect on the oil, the latter must be selected and fed accordingly. If cooling water is at a much lower temperature than the intake air or gas, condensation may take place in cylinder walls, causing poor lubrication. In this case the cooling water should be heated close to temperature of the intake air or gas (Fig. 4).

Relief of initial and first pressure is critical on the cylinders, as well as on the oil selected. In all cases, judgment should be made on examination of cylinder walls, which may be done by removing a valve and using a flashlight. New machines require more liberal feed. When cylinders are well glazed, the feed may be cut back, always providing enough, but not so excess to get in the discharge.

Piston and centrifugal compressors and exhaustors have various different requirements, which are specified by the manufacturer. These types need bearing lubrication only. Large and high speed units usually have pressure lubricated drive bearings. Follow the manufacturer's recommendations.

In general care of compressors, it is advisable to keep an engine room log recording operating data taken at specified intervals during the day. Daily, weekly, and monthly inspection notes should be submitted to the engine room system, lubrication, valves, and packing. Instead of routine checking of the engine—on until major overhaul is needed, make periodic inspection to catch trouble before it develops. Valves should be removed and examined every six months, or even two if the machine is used around the clock. In proper operation

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ation, the valve should have an silky surface and be relatively free from scales. Each valve assembly should be kept separate and parts not interchanged. In replacing gaskets, be sure that the water ports correspond with those in the head. Consideration here of this kind will repay in longer life of equipment, fewer interruptions of service, and lower cost of compressed air.

Proper design and installation of air lines are much to do with efficiency of the system as good maintenance of the machinery. Beginning at the intake, it is important to draw in air as cool and clean as possible. The weight of air handled by a compressor varies directly as the absolute temperature of the intake. If this temperature can be reduced from 80 deg. F. to 60 deg. F., the compressor will have about 24 percent more capacity. Draft and gear continuously cooled into the machine means high maintenance cost and interruption of service. Therefore choose your intake location carefully, away from smoke stacks, exhaust fans, or any similar source of dust.

Good filters should be installed on the intake, with regular cleaning emphasized by the log. The intake should be outside the building; where the air is as cool as possible, on the north side rather than the hot side. Sometimes an intake near the road is indicated in a particular location. If placed lower down, the pipe should be turned upward with the intake at least 10 ft. above ground in order to avoid surface dust. Weather protection must be installed to prevent rain or snow from entering the pipes. (Fig. 5.) Intake piping should be as short and direct as possible, using long radius elbows on all turns. If not over 12 ft. long, intake pipe diameter should equal that of opening into compressor cylinder. If longer, it should be the next size larger.

Need for thorough cleaning of these carbon lines cannot be stressed too much. Boiler craters it has been properly done—oils and debris are found less often to foul the line.

Where a large current trend is met for a section line, it must be glued and surface treated to prevent contact from being drawn in with the air. Above ground, pipe should be standard steel or special riveted. Below ground, it may be vitrified clay with caulked water-tight joints.

Discharge lines need to be of good size, for lines which are too small cause an excessive pressure drop. Loose piping can be especially desirable with long lines. Sharp bends increase friction and should be as few as possible.

Water in the discharge lines reduces efficiency and may cause serious damage to pneumatic tools. Aftercoolers are installed in remedy this. Their effective-

ness depends on the temperature of the cooling water, which should be as low as possible to prevent any further cooling in the line from evaporated added condensation. If the aftercooler temperature is low enough, this will not occur (Fig. 6). The aftercooler should be close to the compressor in order to reduce the air at its hottest, giving a maximum temperature drop in the cooler for maximum condensation.

The receiver handles necessary peak pressures and also eliminates pulsations in the air line, giving a steady more velocity through them. As a result, the line beyond the receiver may be smaller than the line between receiver and compressor, which should never be choked down. Receiver should also be installed in the various departments where the air is used, if there are at some distance from the compressor, to assure a constant supply of dry air.

All receiver—have drain cocks at the bottom which must be drained daily. If no aftercooler is in the system, they should be drained several times a day, particularly in damp weather (see Fig. 7). Receiver safety valves should be tested occasionally by lifting the lever, or by raising the pressure above valve setting.

A shut-off valve must never be put in the line between compressor and receiver without a safety valve on the compressor side of it. Likewise, there must be a safety valve between the receiver and the first shut off valve in the pipeline, if the compressor is connected into an air main, with other compressors (see Fig. 8).

Air hose connections should be made from the top of distribution lines to avoid picking up any possible moisture which is in them. Lines should be blown out before connecting to pneumatic tools. High pressure couplings are required as most lines. For proper maintenance the hose should be continuously turned and the risk and it should be kept on reels when not in use.

Leaks in the piping system are perhaps one of the most common and also most easily corrected losses in a compressor plant. They are usually not hard to find, due to the noise of even a small escape of air. The financial loss from leakage can assume considerable proportions. Leakage of air at 100 lb. pressure through a single 1/2 in. orifice would add up to about \$300,000 a ft. per month. At 50 ps. per 1,000 a ft. this would cost \$300 per month. Air lines should be tested when the plant is not in operation by passing the line and listening down the compressor to see how fast the pressure drops. There is no good a guide as air for some leaks, although a lighted candle is sometimes helpful. Small joint leaks around joints can be hidden checked by liquid soap.

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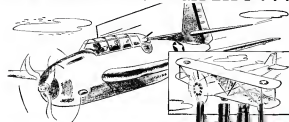
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These tournaments might be called 'bust-a-bite' events' because they protect the place and the members of it in case while they are engaged in offensive actions. The gamblers in the tournaments in clubs, however, are a small

It just happened here! on our porch while they "talk it out" in every direction. It is still raining. They are eating like garbage and even the pond of attack with a continuous buzz of the water from leaves, other men.



## Aircraft Motion

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Another Ingram Farm contribution to the winning of the war. Specially designed strength motor for gun turret, hydraulics, lifts, fuel pumps, fuel controls, underlining, communicating systems, also with built-in gear and fuel stop.

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ABSTRACT, April 1987









AVIATION, April, 1945







44



## FINISHING DIES IS A PAINSTAKING JOB



John Gentry Bell Aircraft Corporation

THIS airplane worker is finishing up a die for a fuselage part for Bell Aircraft's P-39 pursuit planes. It's just another instance of how Bell Aircraft is speeding production with the help of improved finishing operations.

Finishing the die is a painstaking job calling for specialized skill. The rough casting must be scraped and then sanded and finished with coated abrasives to give the required fidelity to the specified contours and to produce the smooth surfaces necessary for perfect stamping operations.

This process is speeded by using Alloxite Brand

Aluminum Oxide Coated Abrasives in various forms specially adapted to the different contours encountered. Abrasive discs, No Lap bands and cloth sheets are used as the particular operation requires. Not used to Bell speed-up of the die preparation process and saving of precious man-hours for tooling operations.

The Carborundum Company has been a leader in developing a number of new forms of coated abrasives to meet the requirements necessitated by war production. A number of these items are described in our pamphlet "Weapon for Production." Send for your copy.

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(Carborundum and others are registered trade marks of the Carborundum Company)

## Points On Plastic In Aircraft Engineering

(Continued from page 141)

little measure of strength as temperature decreases and low coefficient thermal expansion. Molding materials are available in greater form for compression as well as injection molding. Polyethylene has been used as an insulating foil for radio components and seal insulation. It has been designed into and supports for high frequency apparatus and instrument housings, supports for the motor in control valves, anti-prod elements, and instrument lenses.

### Vinyl Co-Polymers

Of the same family group which includes the polyethylenes, the copolymers of vinyl chloride and vinyl acetate have unusual chemical resistance and good impact strength, toughness, and good moldability. They have good electrical and low temperature, good toughness and excellent dimensional stability. Applications include control wheels and molded pulleys.

### Cellulose Acetate

Cellulose acetates possess toughness and resiliency and are available in a tremendously wide range of colors.

Ferms are sheets, rods, tubes, bars, molding powders, molding powders of all every description, films, packaging materials, and foils. Among the applications are numerous industrial and household molded articles, such as radio enclosures, tool handles, automatic hand saws, pulleys, structural lenses, and many other injection molded applications. Other cellulose derivatives of importance are cellulose acetate-butylate, a molding material of high impact strength, and vinyl acetate, a plastic similar to acetate having toughness in sheets and plate and outstanding flexibility at low temperatures. Consequently, this is known as Ethocel.

### Fluorides, Chlorides

These new plastics are noted for high tensile strength and excellent aging properties. It is resistant to heat and most chemicals. Applications include molded parts and, in the form of stretched tubing, gas and tubing, medical lines, and water lines.

In Part II of this series, to appear in May, June, and July, will continue with an examination of comparative properties of plastic materials.

## Dynamic Balancing In Propeller Maintenance

(Continued from page 144)

point, the motor can be held there, another, most important is of sufficient accuracy to obtain the desired results. An interpolation scale could be added as the degrees, but its complication would offset the slight added accuracy. Then, the constant motor rotation a total of five or six, disks to be added, the next one, on the 30 at the scale line. If using five disks, the number is of course halved.

It was necessary to balance a number of propellers to determine the position of each surface with respect to the cen-

ter point. This diagram is applicable only to Dowdell JAC-B airplanes equipped with Wright G-102A engines. It works only with gear ratios which bring the motor and propeller into phase in such a rhythm as to build up a strong vibration pattern, such as 3/2 or a 10/5 ratio, and a 10/4. The latter type can be balanced with another kind of vibration indicator, like a reel, which is more sensitive. It may have to be placed on another part of the airplane to pick up the vibration, and needs its own system planned.

## Single Assembly Line Produces Bombers, Transports

(Continued from page 139)

inspired by means of lift-and-lift-out and slide and can be easily removed. Additional cargo space has been gained by removing the bombardier's compartment and replacing it with a gun turret with an 18-in. front-view extension and a top-shaped roof. Here, too, bombards and door supports are strengthened and protective padding and soundproofing are installed.

The Army Air Force used for transports was in progress that the first B-24's of the line were gradually being made. There was no time to wait while

guns were built and subassemblies tested. The first few transports were completed practically by hand simultaneously with the job of making dies, form blocks, and jigs for the cargo doors, belly opening, and the hundreds of other

But the first Liberator Express was more than 30 days ahead of schedule in meeting off the line—a record production record for Consolidated's Tulsa plant. The first record was achieved last April. The first record was achieved last April. The first record was achieved last April. The first record was achieved last April.



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Distributors of Synthetic Rubber  
and Felt Products**

## Shifting Airliner Revenue and Profit Prospects

(Continued from page 237)

transport. Carried to an extreme, it could lead to the creation by Congress of an independent agency to administer the transportation of airlines under national law and with control at national level.

The greatest obstacle, in attempting to secure the 1943 earnings outlook, is the matter of war contracts. Government contracts—covering military aircraft and passengers for the four years of the war in government-owned planes—has caused the difference between profits and deficits for some of the airlines here.

The post-war use of personnel and facilities for war work, and consequent shortages in the operating overhead. This, of course, has been a factor in the present general trend of airline earnings growth. In addition, the lines have received a small fee for their war work. It is too early, though, to estimate how substantial an effect on airline earnings this war work will have.

Certainly profits will be small in relation to the large and overwhelming volume the airlines are flying for the government. Furthermore, the hope of

the airlines' war effort extends far beyond mere service in the financing of military personnel and, in many cases, to the operation of large multi-engine centers for making changes in loaded planes before they are sent to the front.

As this is written, many of the airlines are engaged in re-equipping their war contracts. In the meantime it might be noted that airline officials are looking to the future. They are not yet offering large profits on war contracts, realizing full well that big earnings on war work would certainly give the way for cuts in passenger, mail, and express rates. Heavy reductions in these rates would leave the airlines "holding the bag" when the war is over and the present wartime traffic demand ceases.

Furthermore, while the substantial effects of war contracts on current earnings picture, it would appear that airline earnings probably reached their wartime peak in 1942. But despite the probable earnings decline for some of the major passenger companies, operations for nearly all were likely to continue in a profitable basis for the duration.

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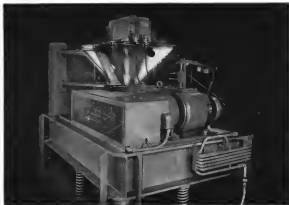
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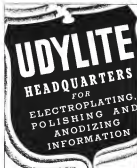
within three minutes the RCA vibrator can shake into pieces any radio set made—and it would probably shake down the building if its 6-ton concrete and steel base weren't mounted on these giant springs.

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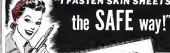
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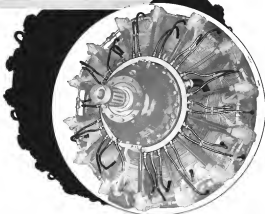
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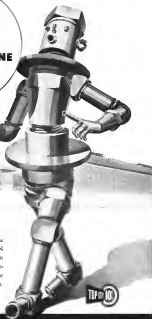
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Name your application, and Cook Electric Company's forty years' experience will be put equally behind it—plus its research, design engineering, laboratory and modern production facilities. Cook is equipped to design and build electrical equipment to your requirements, to build up quickly, and manufacture in quantity under one roof.

The visual annunciator illustrated above is typical of the results obtainable at Cook Electric Company.

This visual annunciator is compact in size with an indicator spring single for clear visibility under varying light conditions. The soupplene drain is flat

black in the unoperated position and bright red in the operated position. In some cases this annunciator is covered with special fluorescent finish.

This annunciator is available for either a.c. or d.c. operation. It may be equipped with auxiliary contacts of  $\frac{1}{4}$ " diameter sub or rated at 6 amperes, 110 volts a.c. non-inductive. This annunciator may be equipped with mechanical reset or electrical reset features.

We suggest that you phone us regarding your requirements for special component designs, special relays or other specially designed electrical equipment, thereby saving time in giving us your requirements, so that our engineers can serve you with greater speed and effectiveness.



**COOK ELECTRIC COMPANY**  
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## Cook Electrical Equipment and Aeronautical Accessories



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AIRWAYS

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This is shown in aircraft plants built for Boeing, Consolidated, Douglas, North American and others. In the Consolidated installation at Fort Worth, a lighting survey by General Electric shows that the concrete floor built with Atlas White cement compared with a grey-cement floor in the same plant—

- Disperses more light throughout the working area.
- Reduces shadows and dark areas.
- Reflects 30% more light to vacant work surfaces.
- Reflects 65% more light to under-side work surfaces.

Thus the floor is a real part of the lighting system. Because it salvages waste light, a light-reflecting concrete floor made with Atlas White portland cement—

- Makes working easier, quicker, and more comfortable.
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- Reduces accidents, errors, scrapings, and shatterings.
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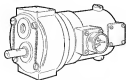
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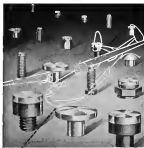


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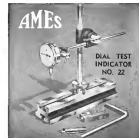
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